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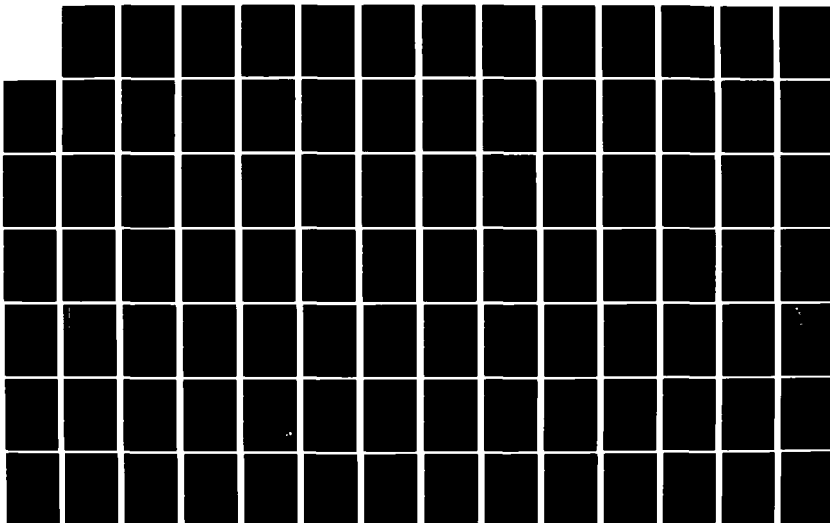
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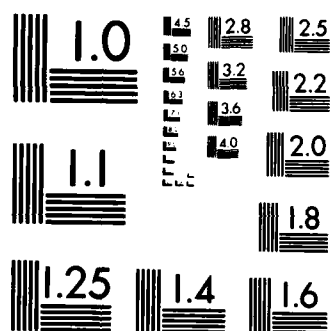
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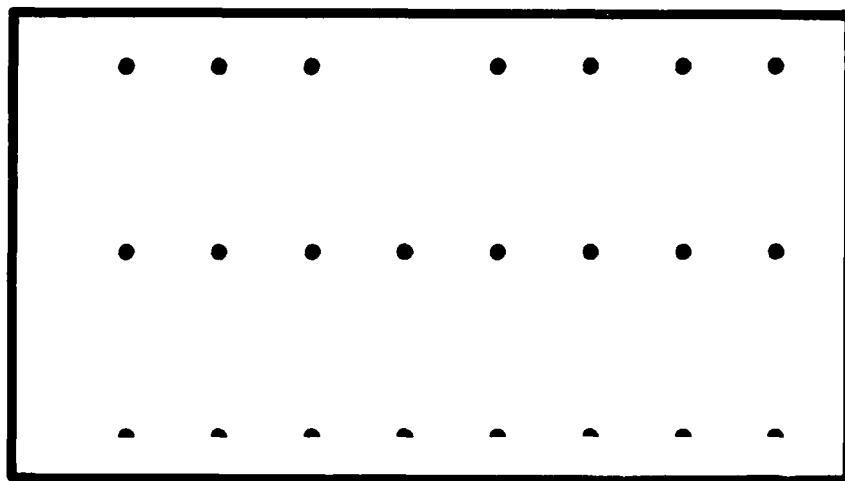
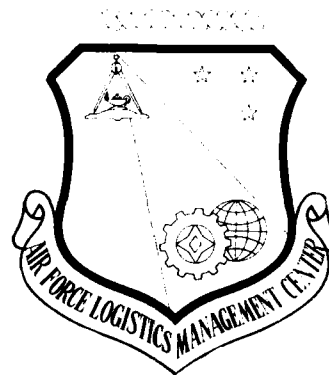




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# AIR FORCE LOGISTICS MANAGEMENT CENTER



**AIR FORCE LOGISTICS MANAGEMENT CENTER**  
**GUNTER AFS, AL. 36114**

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AIR FORCE LOGISTICS MANAGEMENT CENTER

VEHICLE RUSTPROOFING

BY

CAPTAIN DAN E. KING

AFLMC PROJECT 811106

MARCH 1982

AIR FORCE LOGISTICS MANAGEMENT CENTER

GUNTER AFS, AL 36114

FINAL REPORT  
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## SECTION A

### INTRODUCTION

This study was initiated at the request of HQ USAF/LETN (Atch 1). The requirement for rustproofing Air Force vehicles, the rustproofing methods available and the Warner Robins' proposed policy for vehicle rustproofing were all examined. ←

## SECTION B

### PROBLEM

A proposed Air Force vehicle rustproofing policy has been questioned by senior vehicle managers. The current policy is fragmented and adds to the dilemma.

The vehicle engineers and technicians, WR-ALC/MMIRAB, have rewritten MIL STD-1223U, and T.O. 36-1-52 (Atch 2 and 3). The proposed rustproofing policy requires the manufacturer to rustproof all vehicles regardless of use or ultimate destination. The proposed policy triggered HQ USAF/LETN's request for an overall examination of the Air Force rustproofing policy in order to determine what portion of the Air Force vehicle fleet truly requires rustproofing and when this treatment should be applied.



## SECTION C

### METHODOLOGY

1. In developing our recommendations for a new vehicle rustproofing policy we looked closely at the following items:
  - a. Manufacturers' efforts to reduce corrosion potential.
  - b. The Air Force need for rustproofing treatment beyond the manufacturer's production efforts.
  - c. The level of rustproofing treatment called for in T.O. 36-1-52 and MIL STD-1223U.
  - d. Commercial rustproofing practices.
  - e. Geographic locations of Air Force vehicles assignment.
  - f. How Air Force vehicles are used/stored/transported.
  - g. What other services/agencies are doing to rustproof vehicles.
  - h. Cost of the current rustproofing program.
  - i. Cost of the proposed total fleet rustproofing program.
  - j. The effects of a total fleet rustproofing policy on the Vehicle Buy Program.
  - k. The impact of a total fleet rustproofing policy on industry.
  - l. Potential problems in Quality Control and Warranty Administration.
2. The following agencies were contacted.
  - a. All MAJCOM's vehicle management staffs.
  - b. WR/ALC vehicle system manager's office.
  - c. WR/ALC vehicle engineers/technicians.
  - d. WR/ALC Office of Corrosion Prevention and Control.

- e. Engineering and Services Center vehicle management staff.
- f. Other Government services and agencies vehicle management staffs.
- g. Major vehicle manufacturer representatives.
- h. Representatives of commercial rustproofing centers.
- i. Vehicle maintenance activity, Maxwell AFB, AL.
- j. Vehicle maintenance activity, Patrick AFB, FL.

## SECTION D

### DISCUSSION

The eleven specific questions submitted by HQ USAF/LETN are discussed in the following paragraphs with a specific answer to each question and rationale to support that answer.

1. What type vehicles should be treated?

- General Purpose?
- Special Purpose?
- Construction Equipment?

a. Answer - We do not recommend the manufacturer rustproof any vehicles. We believe the steps taken during the manufacturing process satisfactorily inhibits vehicle corrosion at most Air Force bases. The local vehicle maintenance manager should make the rustproofing decision based on the local environment, construction of the vehicle, and its intended use.

b. Rationale.

(1) Major manufacturers of commercial vehicles have, in recent years, introduced new materials and manufacturing processes which have significantly improved the ability of their vehicles to withstand rust and corrosion (Atchs 4 and 5).

Examples are:

(a) The use of aluminum has greatly increased. "In 1978, a typical, U.S.-made vehicle contained 39 percent more aluminum than a similar vehicle in 1975, and total usage is expected to grow to between 200 and 240 pounds per vehicle by

1990. [13]

(b) Plastics are being used in body parts, front and rear ends and trim. "In 1978 a typical U.S.-made vehicle contained 16 percent more plastic than a similar vehicle in 1975, and total usage is expected to grow to approximately 240-300 pounds by 1990. [13]

(c) The substitution of zincrometals, galvanized metals, and zinc-iron alloy steels for standard carbon steel has significantly increased corrosion resistance. [9]

(d) The supplemental use of wax and body coating compounds to seal inside seams is reducing corrosion as well. [9]

(e) Refinements to design, including flow-through rocker panels, have reduced closed sections and entrapment areas and have produced more positive drainage for today's vehicles. [9]

(f) Attaching mouldings with adhesives rather than clips and holes eliminates galvanic corrosion (caused when dissimilar metals are put together without proper insulation). [14]

(g) New pinch weld designs create much smaller metal overlaps and allow for more efficient application of wax sealer.<sup>2</sup>

(2) Some construction, base maintenance and MHE are constructed of thick steel plates and beams. Attachments 6 and 7 are excellent examples of major manufacturers' disbelief that the Air Force or anyone else would seriously consider rustproofing heavy construction equipment.

2. Should all vehicles of a particular type be treated?

-- Vehicles going overseas?

-- Vehicles assigned stateside?

-- Vehicles assigned to dry, noncorrosive areas?

a. Answer - The Air Force should not rustproof all vehicles of a particular type, nor should a vehicle's destination automatically require it to be rustproofed. Vehicle type, destination, and the way the vehicle will be used/stored are factors to consider in determining the necessity for treatment. The local vehicle maintenance manager is the only individual capable of making this decision.

b. Rationale.

(1) We can find no justification for rustproofing vehicles simply because they will be shipped overseas. Standard commercial practices for the overseas shipment of administrative vehicles is to spray bumpers and bright trim with a thin coat of "cosmoline" type preservative. This "export preparation" is removed by the receiving dealership as a part of the dealer preparation. Discussions with special purpose vehicle manufacturers indicate that the majority of the vehicles they ship overseas receive less than Type A (the most comprehensive) export preparation. Thousands of foreign vehicles are annually shipped into the U.S. without being rustproofed. The distance and mode these foreign vehicles travel are the same as U.S. vehicles being shipped overseas and yet Americans do not hesitate to purchase foreign vehicles. The vehicles are not expected to have a shortened life due to their ocean voyage and dockside

handling. Commercial rustproofing centers have no qualms about taking these foreign vehicles, treating them and issuing a warranty ranging from five years to as long as one owns the vehicle. Rustproofing centers overseas offer similar service and warranty to U.S. vehicles.

(2) Current Military Traffic Management Command (MTMC) policy (Atch 8) requires that all military vehicles be loaded below decks and that deck loading will take place only with approval of the affected service.

(3) Vehicles assigned stateside should be rustproofed only after arrival at the using Air Force installation. Determination of vehicle types and quantities to be rustproofed should be a function of local environment, intended use/storage, and the construction of the vehicle. We have large quantities of vehicles which are assigned to bases with moderate climates.

(a) A study, PACER LIME: An Environmental Corrosion Severity Classification System, [12] conducted by the Materials Laboratory at Wright-Patterson AFB compared the corrosion intensity of environments at 158 Air Force and Air National Guard (ANG) bases from Shemya AFB, AK to Howard AFB, Canal Zone. Their goal was to develop a corrosion severity rating scale that could be used to predict aircraft washing, repainting and repair needs. Their analysis looked at relative humidity, proximity to the sea, temperature, sunshine, precipitation and wind velocity. They found that of the 158 locations surveyed only 16 percent could be classified as severe corrosion environments. Some interesting sidelights to their

study were:

1. "Aircraft - like automobiles - are corroded more severely in some environments than others."

2. Rain can be harmful and beneficial.  
Harmful when it washes away soluble corrosion preventatives.  
Beneficial when it washes away pollutants.

3. The presence of salt greatly increases corrosion rates for all metals.

4. Accelerated atmospheric corrosion near the seashore is correlated with airborne sea salt.

5. "Corrosion rates (from sodium chloride in rainwater) 10 km from the shore are approximately the same as corrosion rates for inland."

6. "Emphasis on [proximity to the sea] can be reduced, considering it harmful only if aircraft are normally within 1 to 4 km of sea water. At greater distances it may be neglected."

7. As can be expected, they found locations such as Charleston AFB, Shemya AFB, Vandenburg AFB and Howard AFB to be severe corrosion environments; however, the vast majority (84%) of the bases surveyed were found to have moderate and mild environments.

(b) The map at Attachment 9 shows the bases which are located in the "sun belt." This portion of the CONUS has snow less than five days a year and experiences 90° temperatures at least 60 days per year. Many sections will see an average of 90-120 days of 90° weather each year. [10/11] Within this sun

belt are 32 bases and 21,783 vehicles even after excluding those bases located near the sea coast and all bases in Florida. If a total fleet rustproofing program is adopted, the cost (at 1.5 percent of purchase cost) to rustproof these vehicles at replacement time could reach \$7.8 million in current dollars.

(c) Another map (Atch 10), this one by General Motors, shows the results of their study to determine which portions of the CONUS experience corrosive environments. This map is normally shown in conjunction with a briefing on GM's improved anti-corrosion production techniques.

(d) The argument that Air Force vehicles are moved around frequently cannot be substantiated. Discussions with major commands with mobility missions (MAC, SAC, TAC, and ANG) found that 90-95% of their vehicles remain throughout their life at their original location. For those that are redistributed, it is likely that very few would be sent to a corrosion intensive environment.

(e) Other legitimate issues are:

1. Why should we rustproof vehicles which will be operated and stored inside warehouses, hangars, and bunkers? Warehouse tugs and numerous material handling vehicles are protected from the elements the vast majority of the time. The Air Logistics Centers (ALCs) are the prime examples, but virtually every base has some indoor vehicles.

2. Why should we rustproof vehicles operated primarily on salt-free flightlines? Much of the vehicular equipment assigned to intermediate maintenance, aerial ports, and



other flying support activities spend virtually their whole life on parking ramps and taxiways that must, by necessity, be kept free of corrosive materials.

3. When should treatment be done?

- Before first use?
- Within three months?
- During depot overhaul/remanufacture?

a. Answer - Ideally vehicles should be rustproofed prior to being placed into service. Realistically a vehicle can be rustproofed at any time prior to developing a rust problem. Vehicles undergoing depot overhaul/remanufacture should only be treated or touched up (when previously treated) if the vehicle will be sent to a corrosive intensive environment and the requirement for such treatment is confirmed by the gaining vehicle maintenance manager.

b. Rationale - Some commercial rustproofing centers will treat and warranty (usually for five years) vehicles up to two years old if they determine the vehicle is rust-free. This determination is critical, since the application of rustproofing sealers to vehicle panels already rusting may actually seal in moisture and exacerbate the corrosion process. The Army has developed a special procedure for rustproofing "fielded" vehicles (MIL Spec C-62218). This procedure could be combined with Air Force procedures for accomplishing rustproofing in-house.

4. Who should treat the vehicles?

- Manufacturer?
- Sub-contractor to the manufacturer?
- In-house vehicle maintenance?
- Vehicle Maintenance local contract?

a. Answer - Those vehicles requiring rustproofing should be treated by in-house vehicle maintenance or a local contract which can be monitored by the local maintenance manager (Atch 11).

b. Rationale.

(1) The vehicle maintenance manager is in the best position to determine the actual need for rustproofing, control the quality of the rustproofing treatment, and obtain an appropriate warranty if a local contract is used. He is familiar with his in-house rustproofing costs, the range of services/ prices offered through local contract, and can budget realistically for the next year. The Allied Trades/Body Repair Technical School at Aberdeen Proving Ground, MD, will soon be training AF personnel in rustproofing procedures. The course will be activated approximately 1 April 1982. It will consist of a video tape, Technical Order review, 20-question appraisal test, and one hour of hands-on laboratory training.

(2) The current vehicle rustproofing policy requires administrative vehicles to be rustproofed by the manufacturer; vehicles destined for overseas areas are being treated by the Navy Corrosion Treatment Center (CORTREAT). Some vehicles are rustproofed by local vehicle managers, either in house or by local contract.

(3) There are many shortcomings to the present policy and current procedures have failed to satisfy practically anyone associated with the program. Examples are:

(a) The vehicle manufacturers are unhappy. Most manufacturers cannot perform rustproofing IAW MIL STD-1223U on their assembly lines. To sell rustproofed vehicles to the Air Force they have to subcontract the work to smaller firms. This entails the cost and delay of moving the new vehicles to the subcontractor, waiting for the subcontractor to treat the vehicles and then moving the vehicles back to the primary manufacturer for shipment to Air Force bases. Only the standard warranty is offered and the vehicles are often shipped to Air Force bases where extremely limited warranty rustproofing could be accomplished.

(b) The Navy CORTREAT Centers (Gulfport, Miss., Norfolk, VA, and Port Hueneme, CA) are unhappy and have indicated reluctance to renew our current agreements. The Air Force has been unable to project in advance the number and type of vehicles to be rustproofed or the time frames of their arrival at the CORTREAT Centers. Consequently, the Navy handles the Air Force business as an additive workload versus scheduled work. The inability of the Air Force to project vehicles into the CORTREAT Center has deterred the Navy from hiring personnel dedicated to the task of rustproofing. Many Air Force customers are unhappy with the quality of rustproofing and the delivery delays resulting from the treatment.

(c) The vehicle engineers and technicians are

unhappy with the present system. They must listen to the complaints from the Air Force customers, and they realize the cost of the Navy CORTREAT rustproofing and associated transportation charges are a cost prohibitive method of doing business.

5. What is the time impact of having treatment done by various agencies?

- Manufacturer?
- Sub-contractor?
- Vehicle Maintenance?
- Local Contractor?

a. Answer - Manufacturers currently performing rustproofing in accordance with MIL STD-1223 informed us that delivery of the vehicles is delayed a minimum of two weeks, with instances of 30 days common. Vehicles going through Navy CORTREAT centers often experience longer delays. Vehicle maintenance can rustproof vehicles in an average of eight hours, while an efficient local contract should average no longer than one week, including transit time.

b. Rationale.

(1) Virtually all manufacturers use subcontractors to rustproof administrative vehicles. The delay involves transit time to and from the subcontractor as well as treatment time.

(2) The CORTREAT centers experience different problems. It appears that Air Force was unable to project a steady input schedule of Air Force vehicles; consequently, the Navy could not

hire additional workers. This required that the Air Force vehicles be handled as additive workload, to be worked into the existing production schedule. This becomes especially significant for vehicles going to the Dew Line, Greenland, and Alaska. If these vehicles are not processed through the CORTREAT center and delivered to the port in time for the July-August shipping window, they must wait a whole year for the shipping window to return. There have been instances where CORTREAT was waived in order to expedite shipment.

(3) The in-house maintenance times and local contract times were based on observed rustproofing efforts at Patrick AFB.

6. What is the cost of rustproofing?

-- In absolute dollars?

-- As a percentage of acquisition?

--- When done by the manufacturer or his sub-contractor

--- When done by the base in-house or through local contract

a. Answer - This question cannot be answered in the format used thus far due to the fragmented method currently employed in rustproofing and the varied cost areas associated with the Warner Robins' proposal. The paragraphs below list each cost area and provide our analysis of those costs:

(1) The cost of manufacturer's rustproofing will vary by vehicle type, number of vehicles purchased, and the particular manufacturer; however, the Air Force is currently paying an average of \$160 per light truck/sedan under MIL STD-1223T. This

price does not consider the more comprehensive treatment of 1223U nor the administrative requirements. Estimates by Air Force and industry representatives place the cost of a total fleet MIL STD-1223U rustproofing program as high as 1.5 percent of the purchase price. For the period FY83-87, the Air Force intends to buy \$2.5 billion worth of vehicles (Atch 12); thus, a total fleet treatment program for that period could cost as much as \$37 million.

(2) The cost to rustproof vehicles through the Navy CORTREAT program can be better substantiated. Discussion with Warner Robins Air Logistics Center indicate that during 1981 the Air Force processed 800 vehicles through CORTREAT centers with an average cost of \$400 per vehicle. This cost includes some minor maintenance actions; however, these are secondary to the requirement for rustproofing and constitute a small percentage of the total cost of \$320,000. At Port Hueneme and Norfolk the vehicles were moved directly from the CORTREAT center to the port with little or no transportation expense. At Gulf Port, however, the vehicles had to be transported to New Orleans for shipment. Approximately 600 vehicles were processed through the Gulf Port CORTREAT center last year. With transportation cost averaging \$225 per vehicle the total transportation bill amounted to approximately \$135,000. Thus the total 1981 CORTREAT for 800 vehicles was \$455,000. These funds were taken from the Depot Purchased Equipment Maintenance (DPEM) fund. Assuming that only special purpose vehicles were processed through CORTREAT (administrative vehicles should have been treated under MIL

STD-1223), and assuming the vehicles were in quantities proportional to their fleet inventory percentages, the cost to rustproof these special purpose vehicles equated to 1.5 percent of their purchase price.

(3) The cost of rustproofing (in accordance with MIL STD-1223U) an average vehicle, using in-house labor and materials is:

	<u>Material</u>	<u>Labor</u>	<u>Total</u>
Type A (For Severe Corrosion Areas)	4 gal @ \$20/gal = \$80	8 hrs @ \$9.00/hr = \$72.00	\$152
Type B (For All Other Areas)	2 gal @ \$20/gal = \$40	4 hrs @ \$9.00/hr = \$36.00	\$ 76

The above figures were computed using material and labor hour data from Patrick AFB, Fl. They have extensive experience in rustproofing vehicles due to their unique location on the east coast of Florida. Labor costs (E-4 hourly wage) were taken from AFR 177-101, General Accounting and Financial System at Base Level.

(4) The cost to commercially rustproof an intermediate size sedan ranges from approximately \$90 to \$275, and will vary between locations and the firm conducting the treatment. This variation is a positive feature, because it gives the maintenance manager flexibility in the amount of protection purchased. Some vehicles require only superficial treatment, while others may need comprehensive coverage.

b. There are other costs associated with vehicle

rustproofing. Examples are:

(1) Regardless of who applies the treatment, the manufacturer or his subcontractor, it will be extremely difficult for Air Force users to determine the quality of the product. A visual check requires substantial disassembly on some vehicles, and could easily average four hours labor. At nine dollars per hour (E-4 wage), the acceptance Limited Technical Inspection for each new Air Force vehicle rustproofed by the manufacturer would cost \$36.00 more. At locations such as Patrick AFB, FL, this could be money well spent. At Davis Monthan AFB, AZ, it would be a serious waste of manpower. This cost can be avoided when in-house or local contract maintenance is used.

(2) Personnel performing the initial quality control check would need to be trained, not only to check the manufacturer's work, but to touch up minor flaws in the treatment. Patrick AFB, with their extensive rustproofing experience, found that approximately two weeks of OJT is required to bring a mechanic to 5-level proficiency. This equals \$720.00 at E-4 wages. Once again, this training could be well used at severe corrosion locations like Kadena AFB, Okinawa; it would be extravagant training at Holloman AFB, NM.

(3) Under Warner Robins' proposed total fleet concept, each base vehicle maintenance shop would require equipment to touch up flaws in manufacturers' treatment or to increase the level of treatment to meet local conditions. This equipment costs approximately \$1050.00 per base. Total Air Force cost would be \$126,000. (Attachment 13). An extremely limited number



of vehicle maintenance shops currently have this equipment. Purchase, storage, and maintenance of this equipment are fully justified at Andersen AFB, Guam; however, it would be an unnecessary expense at Maxwell AFB, AL.

7. What are payoffs to rustproofing?

- Enhanced vehicle appearance?
- Increased life expectancy of vehicle?
- Reduced body repair actions?

a. Answer - These payoffs could be expected assuming that a vehicle received quality rustproofing treatment and that the vehicle is operated in a severe corrosion environment.

b. Rationale.

(1) Rustproofing will reduce the incidence of corrosion. It is not fool-proof, but it is a legitimate preventative measure. As noted previously, the protection gained is directly related to the quality of application and assumes the vehicle is in a corrosive environment. It must be remembered that the degree to which these payoffs occur depends on the environment and the way the vehicle is constructed. A rustproofed bulldozer at Nellis AFB, NV is not going to look better or last appreciably longer than an untreated one. Vehicles made of heavy gauge metal rely primarily on a coating of primer and paint. If the integrity of that coating is maintained, no further protection is needed.

(2) The prospect of obtaining and controlling warranty

for this type of treatment creates some interesting questions:

(a) Will the Air Force get a warranty at all?

Although it is costing approximately \$160 per vehicle to have administrative vehicles rustproofed in accordance with MIL STD-1223T we are still getting the standard three year warranty which would be available whether the vehicles were rustproofed or not. In the case of General Motors, they use a Ziebart subcontractor. However, the five year warranty which Ziebart provides is not passed along to the Air Force users. The Ziebart five-year warranty requires the vehicle to be checked once a year. Obviously, some GM vehicles are required at locations where this annual inspection cannot be made. Suppose that a Ziebart rustproofing center were close by, it is conceivable that the Ziebart manager would become concerned about having to perform numerous annual inspections/repairs on vehicles which he did not initially treat or collect revenue. It must be remembered that Ziebart and other major rustproofing centers are franchise operations owned and operated by local businessmen.

(b) Would warranties on special purpose equipment be supportable? Under the Warner Robins proposal, special purpose vehicles would be treated and warranted for five years. Many types of special purpose vehicles are made at only one or two locations and do not enjoy a nation/world-wide dealership-distribution system. Confirmation of manufacturer rustproofing shortcomings would be difficult, at best. Correction of these shortcomings by warranty could easily become unprofitable to the Air Force considering time and administrative costs.

8. Who should pay for treatment?

- Buy Program?
- AFLC Obligation Authority?
- Unit O&M funds?

a. Answer - We believe unit O&M funds are the most appropriate source for the vast majority of vehicle rustproofing. Those vehicles being rustproofed/retouched during depot repair/remanufacture (see question 3) should be paid for by AFLC as a normal part of the depot repair process.

b. Rationale - We do not believe it appropriate to use the Vehicle Buy Budget (3080 appropriation) to purchase a rustproof treatment that is readily available through O&M in-house or local contract effort. The Air Force vehicle fleet managers have labored unsuccessfully for years to buy replacement or additional vehicles when needed. Programmed vehicle buys through FY87 will allow purchase of all vehicle shortfalls and the replacement of all vehicles that qualify for replacement. This turn-about occurred after an exceptional effort to highlight vehicle requirements and the impact of past inadequate funding. If the vehicle community were to obligate acquisition dollars for rustproofing, an adversary might construe this to mean that the Air Force has been overstating previous requirement figures. It is our belief that a total fleet rustproofing plan, using manufacturer rustproofing, would ultimately reduce the Air Force Vehicle Buy Program by thousands of vehicles....vehicles that were recently declared essential to insure an adequate state of readiness.

9. What do others do?

-- Other services?

-- Commercial industry?

a. Answer - We found that other major vehicle users, both government and private sector, use a selective program for rustproofing their vehicles versus a fleet-wide treatment.

b. Rationale - The following vehicle rustproofing programs were reviewed:

(1) The Army conducts vehicle rustproofing treatment at three levels: commercial, semi-tropical, and full-tropical. Their program calls for no treatment of construction or combat vehicles and selective treatment of other type vehicles. They have developed a MIL STD-C62218 for the rustproofing of vehicles already fielded. This could be useful to the Air Force in those few instances where untreated vehicles are redistributed to severe corrosion environments.

(2) The Navy is concentrating rustproofing treatment on its wheeled highway vehicles, but is not treating construction or MHE vehicles. Follow-on treatment is left to the discretion of the local maintenance manager.

(3) The General Services Administration (GSA) uses a selective approach to rustproofing. Administrative vehicles are treated in accordance with MIL STD-1223, with other CONUS vehicles receiving required treatment at destination. Construction equipment is not being treated.

(4) The Postal Service vehicle fleet consists primarily of jeeps. These vehicles receive a special rustproofing

specified in their purchase contract. The extent of treatment is somewhat less comprehensive than the standard commercial rustproofing treatment and significantly less comprehensive than MIL STD-1223U. According to the American Motors representative who coordinates this treatment with the Postal Service, the rustproofing is applied to approximately eight critical points on the lower body. It must be remembered that these vehicles have no door panels, upholstery, etc., to restrict the application of rustproofing, thus, a low-per unit cost allows fleet-wide treatment.

(5) American Airlines initially approached the vehicle rustproofing question much the same as Warner Robins. They initiated a fleet-wide rustproofing program, but later determined it to be a poor investment and discontinued it after a few years. They now follow an extremely selective rustproofing program, focusing treatment on vehicles that work in water/chemical intensive environments (examples: latrine trucks, potable water trucks, deicers, etc.). They treat the vehicles one time and have no follow-up program. They do not treat their "thin-skin" general purpose vehicles, tow tractors, baggage carts, or conveyor trucks. They note that their parking ramps, taxi ways and aprons are kept free of salt and other corrosive chemicals, thus reducing the opportunities for vehicle corrosion.

10. What is the cost of not treating the vehicles? (Possibly the hardest question of all)

a. Answer - The costs are not available at this time. The present Vehicle Integrated Management System (VIMS) does not clearly identify effort expended on corrosion control. It combines this effort along with other body/component repair actions. Electrical failures, replacement of fuel/fluid lines, radiator repair and other mechanical problems are often worked in the general/special repair shops and are not currently reflected in a survey of allied trades work orders. We can safely assume that corrosion control efforts vary widely from location to location.

b. Recommendation.

(1) We recommend a Management Equipment Evaluation Program (MEEP) study to determine the impact of non-treatment. Such a study will require at least a year's data and should involve bases in varying climates and geographic locations. The workorder documentation would need to be more explicit in the description of the work accomplished and how the work was tied to corrosion control. Some effort, we do not know how much, is required in all shops as a result of corrosion.

(2) Additionally, Systems Research Laboratories, Inc., working with the Air Force Material Laboratory (AFWAL-MLIN), at Wright-Patterson AFB, has developed and partially tested corrosion inhibitors, which, when mixed with aircraft wash/rinse water neutralizes the effects of salt and other corrosive compounds which have attached themselves to the aircraft (Atch

14). These inhibitors appear to have potential use in controlling corrosion in our vehicle fleet. When used in a recirculating water system, cost were reportedly kept to \$1.00 per aircraft wash/rinse. Recommend that further evaluation to determine the value of these inhibitors, especially at locations with severe corrosion environments. This evaluation could be accomplished simultaneously with the MEEP study.

11. If treatment is to be done by local means, who decides the geographic location needing vehicle rustproofing?

-- Air Force?

-- MAJCOM?

-- Local Vehicle Maintenance Officer?

a. Answer - We believe the local vehicle maintenance manager is in the best position to determine his vehicles' requirements for rustproofing.

b. Rationale - Major Commands may be aware that the environment at Base A is generally corrosion intensive, but they do not know which vehicles are operated/stored indoors or in salt-free areas. Nor do they know that certain pieces of equipment are used in direct contact with salt water, urea or other corrosive substances. Vehicle managers at the Air Force level should only become involved to the extent that certain groups of vehicles may need "export protection" (see Question 2) or rustproofing treatment if the vehicles are destined for a remote region (and corrosive environment) with no organic or

commercial rustproofing sources available. These vehicles should be handled as exceptions and receive commercial treatment prior to shipment.



## SECTION E

### CONCLUSIONS/RECOMMENDATIONS

1. The Air Force does not need a vehicle rustproof policy that results in treatment which can be neither effectively quality controlled or warrantied. Nor does it need an umbrella program which rustproofs every vehicle to satisfy a relatively small requirement where a severe corrosion environment exists. Therefore, we recommend a rustproofing policy that allows selective treatment of vehicles with determination of requirements at base level. The most realistic and cost efficient vehicle rustproof program available to the Air Force is one controlled by the local vehicle maintenance manager and paid for by O&M funds (Atch 16).
2. The following impacts are associated with such a program:
  - a. The Vehicle Buy budget should serve its original purpose -- buying the maximum number of vehicles possible and not spending the money on rustproofing. Attachment 15 provides a sample list of vehicles which could be purchased (up to \$37 million more between FY83-87).
  - b. The Depot Purchased Equipment Maintenance (DPEM) fund could be relieved of supporting vehicles being sent through Navy CORTREAT thus saving approximately \$455,000 (FY81 cost).
  - c. Local vehicle maintenance managers would no longer have to check the quality of the manufacturer's rustproofing treatment during the acceptance inspection. This represents a \$36 savings (O&M funds) for each new vehicle purchased.

d. Local vehicle maintenance managers at locations where corrosion is not severe would not:

(1) Have to train personnel to conduct the initial acceptance inspection or rustproofing procedures. This represents a \$720 (O&M funds) offset for each mechanic not trained.

(2) Have to purchase, maintain and store rustproofing equipment/material. This would mean a savings of approximately \$1050.00 (O&M funds) per base in equipment purchase price alone.

(3) Have to conduct the annual follow-up inspection in accordance with T.O. 36-1-52 for a savings of \$9 (O&M funds) per vehicle.

e. Only those vehicles actually requiring treatment would be treated.

f. Vehicle maintenance managers, who elect to rustproof vehicles in their fleets, would be able to control the quality of treatment, whether done in-house or by local contract.

g. Vehicle maintenance managers using the local contract option could obtain and administer a reasonable warranty. (Dollar value uncertain, but has to be better than current or previously proposed policies.)

h. Vehicle manufacturers could get back to building a vehicle to commercial standards. No longer would they have to subcontract the rustproofing or maintain rustproofing technical manuals and reports for the government. Vehicle costs and delivery delays should decrease by approximately 1.5 percent and 2-4 weeks respectively.

3. The above program is in keeping with the President's current

program on Fraud, Waste and Abuse (Atch 17). The defense budget is constantly being scrutinized by Congress and the media. The Air Force can ill afford policies which solve localized problems with Service-wide expenditures. A fleet-wide rustproofing policy (even within types of vehicles) places the Air Force in a vulnerable position. It would be difficult to explain why we spend acquisition dollars to rustproof vehicles for Davis Montham AFB and Holloman AFB. It would be impossible to explain why the Air Force rustproofs vehicles operated and stored in-doors. The decision-making authority should be at the management level most concerned with its success - the local vehicle maintenance manager. This is complying with the spirit and intent of Buck Stop.

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DEPARTMENT OF THE AIR FORCE  
HEADQUARTERS UNITED STATES AIR FORCE  
WASHINGTON, D.C. 20330

28 OCT 1981

REPLY TO  
ATTN OF

LETN

SUBJECT Vehicular Rustproofing


TO AFLMC/LGT

1. In the recent past, many major commands identified inadequate vehicle rustproofing as an area of serious concern. WR-ALC recognized this concern and established an internal working group to review vehicle rustproofing techniques. As a result of their work within the Air Force, other services, and industry, MILSPEC 1223 has been significantly improved. All are confident that the specification adequately prescribes materials and techniques for rustproofing vehicles.

2. In the past 12 months we have come a great distance in refining the "how" of vehicle rustproofing. As a result, we believe it is appropriate to examine Air Force policy concerning the "what" and "when" of vehicle rustproofing. To this end, we would ask you to initiate a study which addresses the questions contained in Attachment 1. All work on this subject should be done in close coordination with WR-ALC.

3. Your interest in this subject matter is greatly appreciated.

FOR THE CHIEF OF STAFF

  
C. M. CUNNINGHAM, Jr., Col, USAF  
Chief, Vehicle & Equipment Div  
Directorate of Transportation

1 Atch  
Study Questions

cc: HQ AFLC/LOWC  
WR-ALC/MMIV

## VEHICULAR EQUIPMENT RUSTPROOFING

- What type vehicles should be treated?
  - General Purpose
  - Special Purpose
  - Construction Equipment
- Should all vehicles of a particular type be treated?
  - Vehicles going overseas?
  - Vehicles assigned stateside?
  - Vehicles assigned to dry, noncorrosive areas?
- When should treatment be done?
  - Before first use?
  - Within three months?
  - During depot overhaul/remanufacture?
- Who should treat the vehicles?
  - Manufacturer?
  - Sub-contractor to the manufacturer?
  - In-house vehicle maintenance?
  - Vehicle maintenance local contract?
- What is the time impact of having treatment done by various agencies?
  - Manufacturer?
  - Sub-contractor?
  - Vehicle Maintenance?
  - Local contractor?

- What is the cost of restproofing
  - In absolute dollars
  - As a percentage of acquisition
    - When done by the manufacturer or his sub-contractor
    - When done by the base in-house or through local contract
- What are payoffs to rustproofing?
  - Enhanced vehicle appearance?
  - Increased life expectancy of vehicle?
  - Reduced body repair actions?
- Who should pay for treatment?
  - Buy Program
  - AFLC Obligation Authority
  - Unit O&M funds
- What do others do?
  - Other services
  - Commercial industry
- What is the cost of not treating the vehicles? (Possibly the hardest question of all)
- If treatment is to be done by local means, who decides the geographic location needing vehicle rustproofing?
  - Air Force
  - MAJCOM
  - Local Vehicle Maintenance Officer

MIL-STD-12230  
15 February 1981  
SUPERSEDING  
MIL-STD-1223T  
15 November 1978

MILITARY STANDARD

ADMINISTRATIVE WHEELED VEHICLES  
TREATMENT, PAINTING, RUSTPROOFING, IDENTIFICATION  
MARKING, DATA PLATES AND WARRANTY NOTICE STANDARDS



FSC-2310-2320-2330



5.3 Rustproofing. When rustproofing is required by specifications or other procurement documents, the vehicle shall be provided with rustproofing, using material conforming to MIL-C-0083933(MR) dated 5 October 1970 with Amendment 3, dated 12 August 1971. Aluminum or stainless steel surfaces need not be rustproofed. Fiberglass, rubber, or other non-metallic surfaces need not be rustproofed.

5.3.1 Identification. A decal identifying the rustproofing processor shall be furnished and mounted in a visible location inside the vehicle or under the hood. The decal shall conform to material and performance requirements of MIL-M-43719 type I, class 1, and shall include at least the following information:

- a. Contractor/Company rustproofing the vehicle
- b. Rustproofing material used and its manufacturer
- c. Date vehicle was rustproofed.

5.3.2 Spray tools. Manufacturer's standard proper spray tools shall be utilized, for inserting through maximum 1/2-inch hole, to spray appropriate pattern to insure complete internal coverage.

5.3.3 Instructions. Unless otherwise specified, illustrated rustproofing instructions covering the vehicle to be rustproofed shall be prepared and maintained by the contractor in technical manual form. The manuals shall specify required tools, materials, procedures and application for proper rustproofing of the specific vehicle. The material shall be applied by trained rustproofing technicians.

5.3.4 Inspection. The contractor shall maintain records of tools, technical training and materials used. Written inspection procedures shall be available. Quality assurance reports shall be submitted to Government representatives.

5.3.5 Application. The application of rustproofing material shall include at least the following:

- a. All surfaces to be rustproofed shall be clean, dry, and free from loose material.
- b. Complete coverage of all inner surfaces requiring protection by means of properly atomized spray.
- c. Spray tools to be inserted into closed areas through drilled access holes of a maximum of 1/2-inch diameter. After application, the holes shall be sealed with weather resistant plastic or rubber caps.
- d. Material shall penetrate all seams and crevices.

- e. Drain holes or passages shall not be blocked.
- f. Exterior of the vehicle shall be free of rustproofing compound except cracks, crevices, and seams of decorative moldings.
- g. Heat shields, heat diffusing devices, catalytic converters, and areas directly above the exhaust system shall be free of rustproofing.
- h. Rustproofing compound shall be non-injurious to all materials used in automotive construction.

5.3.6 Areas. The surfaces to be protected shall include at least, but be not limited to, the following areas, as applicable:

- a. Front: Inside surface of the radiator shield and grill panel assembly supports, gravel shield panel, and headlight associated hardware and headlight doors (see figures 1(A), 2(A), and 3(A)).
- b. Fenders: Complete fender wells (see figures 1(P) and 2(N)), eyebrows, undersides of fenders, all enclosed, boxed-in, and support sections (see figures 1(D), 2(L), and 3(G)).
- c. Hood and deck lid: All underside areas of the hood and rear area of deck lid (see figures 1(B), 1(G), and 2(C)) where moisture may settle or be retained, and the complete inside of all boxed-in or support sections.
- d. Cowl: Cowl, complete inside of all enclosed or boxed-in support sections and double paneled sections (see figures 1(E), 2(D), and 3(B)).
- e. Doors: Front and rear, inside of outer panel including front, rear, and bottom panel, and upper frame on trucks only (see figures 1(M), 2(K), and 3(K)).
- f. Pillars: Automobiles: inside front, center, and rear pillars at bases to roof line. Trucks: complete inside front, center, and rear pillars (see figure 1(F)).
- g. Dog leg: All internal areas and boxed-in sections (see figures 1(L), 2(J), and 3(J)).
- h. Quarter panel: Inside quarter panel, rear fender well, boxed-in, and double paneled sections (see figures 1(K) and 2(P)).
- i. Light wells: All front, side, and taillight wells (see figures 1(C), 2(B), and 3(L)).
- j. Rear trunk and panel: Rear trunk panel assembly and all boxed-in or double paneled areas and seams, including the hinging area of the deck lid and rear gravel shield (see figure 1(G)).

- k. Seams and moldings: All open seams and metal-to-metal (non-adhesive backed) moldings are to be sealed (see figures 1(R), 2(M), and 3(F)).
- l. Rocker panels: All inner areas and boxed-in sections complete (see figures 1(N), 2(H), and 3(H)).
- m. Body floor supports: All underside body floor supports; enclosed and boxed-in sections, as well as exposed areas (see figures 1(J), 2(G), and 3(E)).
- n. Unitized construction: Complete frame including the inside of all boxed-in and exterior sections of unitized construction.
- o. Underside: Except as specified in 5.3.5(g), the underside complete including gas tank, floor, wheel housing, fender lips, brake lines, gas lines, support clips, and exposed areas (see figures 1(T), 2(R) and 3(M)).
- p. Station wagon tailgate: Complete inside surfaces of the outer panel, lower panel, and all seams (see figure 1(H)).
- q. Truck cabs: All inside roof seams, roof supports, drip rail seams, and roof shelves including all boxed-in areas of the roof overhang. Complete inner surfaces of rear double panels of cab, rear pillars, and all boxed-in support sections (see figures 2(E), 2(F), 3(C), and 3(D)).
- r. Panel and pickup trucks: All rear double paneled and boxed-in sections as well as any rear gates or doors, to be treated the same as the front doors to roof line and complete roof through inner seams.
- s. Truck bodies: Inside all enclosed, boxed-in, and double paneled areas including doors or gates to roof line and roof through overhang inner seams. Insulated bodies to rub rail or side panel seam, whichever is higher.
- t. Truck chassis: Complete frame inside and out, springs, brackets, running gear (excluding brake drums) and all appropriate underneath metal.
- u. Trailers and semitrailers: All sides of the main frame members and crossmembers and the inside surfaces (top, bottom, side) of the side rails. All frame enclosed surfaces (fifth wheel plate, lights), box sections, brake lines, lighting conduit, clips, all other frame underside exposed areas, and body areas as outlined in "s" above.

5.3.6.1 Tropical. When specified, in addition to the areas above, the following areas shall be rustproofed:

- a. Roof: Inside area of roof and inside of roof panels.
- b. Inside floor: Under floor mat, complete interior floor.

TECHNICAL MANUAL

CORROSION PREVENTION AND CONTROL  
FOR AIR FORCE VEHICLES

I. GENERAL

1-1 SYNOPSIS: This Technical Order establishes policies and procedures for controlling materials, processes, and design principles to be incorporated in, or performed upon Air Force vehicles for Corrosion Prevention and Control; hereafter abbreviated COPCON.

1-2 DEFINITIONS: (Listed Alphabetically)

A. CORROSION: Deterioration resulting from the action of service environment upon vehicle components.

B. CORRTREATMENT: Initial COPCON performed outside the vehicle factory.

C. DESIGN COPCON: Structure and/or materials incorporated in vehicle design for the purpose of COPCON improvement.

D. FOLLOW ON COPCON: COPCON performed subsequent to the delivery of vehicles to Air Force using activities.

E. INITIAL COPCON: COPCON performed prior to the delivery of vehicles to Air Force using facilities (MIL-STD-1223 and/or T.O. 36-1-52).

F. FACTORY RUSTPROOFING: Protective coatings applied at the factory to manufacturer's finished vehicles to retard corrosion (MIL-STD-1223).

G. UNDERCOATING: The application of coatings to vehicle underbodies for the purpose of sound and/or heat insulation. Undercoating is not a substitute for effective rustproofing.

1-3 AIR FORCE POLICY: The aim of vehicle COPCON shall be to enhance safety, extend service life and to reduce costs, repair man-hours, and systems and equipment downtime.

1-4 INITIAL COPCON: Each new Air Force vehicle shall receive initial COPCON calculated to yield maximum safety, mission adequacy and life cycle economy. Initial treatment may involve any combination of Design COPCON, Factory Rustproofing, and/or Corrtreatment (see para 1-2). Each processor contributing to

initial COPCON shall attach a corrosion treatment decal applied to the front left hand door (front right hand door on buses) documenting the following data as a minimum:

- A. Material(s) used
- B. Organization performing COPCON
- C. Date COPCON was accomplished
- D. Reference to process records

#### 1-5 RESPONSIBILITIES

A. Maintenance Engineering Managers per T.O. 00-25-115 will be responsible for specifying initial COPCON levels for all vehicles under their management. Their assigned COPCON levels shall be coordinated thru applicable ALC corrosion monitors and the ALC corrosion manager.

B. Local Commanders shall exercise final responsibility for COPCON maintenance to improve initial COPCON levels on all vehicles under their command as they deem advisable in the light of safety, mission adequacy and/or lifecycle maintenance economy. Commander authorized COPCON levels shall meet or exceed initial COPCON requirements established for para 1-5A. Commanders shall coordinate final COPCON levels thru the Office of Corrosion Management at command and USAF levels per AFR 460-44.

C. Vehicle Maintenance Officers shall be responsible for assuring that local Commander's COPCON standards are met/preserved by follow on COPCON completely documented in appropriate records.

#### SECTION II PROCEDURES

2-1 INITIAL COPCON: Each new Air Force vehicle must receive initial COPCON per TYPE A or TYPE B under this technical order.

A. TYPE A COPCON: Requires complete treatment of all body surfaces and boxed in internal structures. The areas of application shall be as a minimum those identified in Tables 2-I and 2-II.

B. TYPE B COPCON: Requires as a minimum the COPCON as defined by MIL-STD-1223.

C. Vehicles destined for the following facilities shall receive Type A COPCON:

AAC: All facilities

CINCPACAF: All Facilities  
SAC: Anderson AFB, Guam, Ramey AFB, P.R.  
USAFE: All Facilities.  
CONUS: Patrick AFB; Homestead AFB; MacDill AFB; Tyndall AFB; Hurl-  
burt Field; Myrtle Beach AFB; and Langley AFB; Charleston AFB  
SOUTH COM: Panama Canal Zone

D. ACCEPTANCE INSPECTIONS: Shall be performed under the Vehicle Maintenance Officer's responsibility in the following detail.

(1) Each DD Form 250 shall be inspected for the indicated level of initial COPCON.

(2) Each vehicle shall be inspected to determine that Type A or Type B processing (whichever is required by the DD Form 250) has been properly accomplished.

(3) The COPCON on each vehicle shall be inspected for adequacy under the Commander's COPCON requirements.

E. REPORTS: The DD Form 250 and the vehicle record AF Form 1828 shall reflect all deficiencies under paragraphs D (1 and 2). Each vehicle will be scheduled for follow on COPCON necessary to correct discrepancies in paragraphs D (1 thru 3). Results will be recorded on the AF Form 1828. The vehicle maintenance officer will report all COPCON discrepancies noted during the acceptance inspection to WR-AIC by submitting an Unsatisfactory Report (UR) in accordance with T.O. 00-35D-54.

2-2 FOLLOW ON COPCON: Under the Maintenance Officers responsibility shall be scheduled as deemed necessary to:

A. Upgrade COPCON to full local Commander's standards per E above (new vehicles).

B. To inspect yearly and restore vehicles to required COPCON standards as they suffer deterioration thru age/service.

C. Failure to report, document and/or perform yearly COPCON shall constitute vehicle abuse.

2-3 PREPARATION FOR TREATMENT.

A. The instructions outlined herein are intended for all makes and models of AF vehicles, new or used. The figure data of Tables 2-1 and 2-11 is for concept only. However, it must be considered that personnel assigned to effect this treatment will exercise good judgment in performing the task efficiently and not refrain from assuring all corrosion prone areas are treated. Particular attention must be given to those sections of a vehicle

that are most susceptible to corrosion when operating in tropical, sub-tropical, and coastal regions and in areas where salt solutions are used for snow and ice removal.

#### B. Inspection.

(1) Vehicles received by organizations shall be inspected to determine compliance with application areas as shown in Tables 2-I and 2-II. Each vehicle is to be re-examined yearly to determine the areas requiring re-processing. This will best be accomplished during regular yearly intervals when touch-up can be performed in a minimum of time.

(2) It is imperative that drain and vent holes have not become clogged. After applying rust-proofing materials, all drain holes or passages must be checked to ascertain that excess material has not accumulated in the drain area, restricting use of the drain hole.

(3) Examine vehicle for inspection type openings before drilling any special holes. Holes drilled for the purpose of applying material should not exceed 1/2 inch diameter. Such holes are to be blocked or capped with plastic or rubber seal type caps after completing of rustproofing in the area. There are a number of manufacturers marketing plastic plugs for closing holes drilled to reach interior areas.

#### C. Cleaning.

(1) Cleaning of the vehicle will require placing on lift and raising to proper working level. The recommended procedure is to begin at the front and work toward the rear as follows: Front splash panel, headlight area, front fenders, panels and supporting members, fender beads, floor pan, rocker panels, quarter panels, gasoline tank, tail and back-up light area and rear splash panel. Remove heavy deposits of rust, loose undercoating, mud gravel and foreign material by using wire brush, putty knife, screw driver, rubber hammer or improvised tools, paying particular attention to seams welds and corners. Ordinary road film can be sprayed over without preparation.

(2) For an extremely dirty underbody it may be advisable to PRESSURE clean the area first. DO NOT use steam clean method. Warm water and mild detergent solution should suffice. The coating materials listed herein have excellent adhesion to moist or wet surfaces and will displace water permitting immediate application of the coating compounds after surfaces have been washed.

#### D. Application

(1) The rustproofing materials recommended herein are to be sprayed on. Spraying is quick and effective and is the best means of

coating hard to reach areas. The majority of application will require an airless type spray pump and an airless spray tip of 0.031 orifice diameter with a 100 mesh screen. It may be necessary to use flexible tip extensions. An air pressure of 125-155 psi is recommended for applying the Grade 1 material. It is extremely important that the spray equipment be adjusted to spray the particular area. Test the gun on an open spray pattern to insure that inside or hidden body panels will have complete coverage without using excessive amounts of compound.

CAUTION:

With airless spray equipment, the compound is discharged from the nozzle at extremely high pressure and could easily penetrate the skin. To avoid serious injury, keep fingers away from the first few inches of spray leaving the nozzle. It is recommended that either a face shield or goggles be worn while operating the pump.

(2) A spray booth or separate spraying area is not required for applying the compounds. It is advisable to work in a well ventilated area, such as a lubrication bay. Masking of vehicle prior to application of these corrosion preventive materials is not required, neither is removal of components except wheels, which is optional.

(3) Material should be applied in layers of equal thickness not to exceed 1/16 inch. Coatings of greater thickness waste material.

(4) When any excess rustproofing material appears on exterior surfaces due to overspray (drips or runs in seams, smudged surfaces or windows and upholstery), it shall be removed in a manner which leaves the vehicle clean. A mixture consisting of equal parts of mineral spirits and water is recommended for removal of such residue. Care should be exercised to prevent excessive solvent solutions from removing rustproofing compounds from treated areas.

(5) It is of special concern to insure that processing does not leave vehicle which smudged windows obscuring driver vision or has not inadvertently caused interference with any mechanical or electrical functioning of the vehicle.

2.4 TABLES OF APPLICATION

A. Areas described in Table 2-I apply to all commercial general purpose vehicles whether passenger car, small or large truck, station wagons, or similar equipment. Table 2-II lists special purpose vehicles having distinct features requiring application data not explicitly covered by general application requirements of Table 2-I.



NOTE:

Under ordinary circumstances, the failure to provide protective coatings on interior surfaces is not a matter of major concern unless the geographical area is one of an adverse corrosion prone environment. Neglect of these inner surfaces, under above conditions, quickly results in internal destruction of parts or assemblies, beginning in the hidden or inside areas and working outward. Therefore, the anti-corrosion measures that must be considered are twofold, (1) provisions for protection of exposed surfaces, and (2) provisions for protection of inner surfaces which are often completely bare metal without any prior protective coatings. Some rocker panels, dog legs, hood areas, and center posts may have hidden baffles. Probing with applicator wand will locate these and determine need for hole drilling and treatment. Both sides of such baffles should be coated.

2.5 EQUIPMENT AND MATERIALS REQUIRED.

A. The following items of equipment or equivalent, are required in performing vehicle rustproofing as outlined herein:

ITEM

Automotive Vehicle Hydraulic Lift

Drum Pump, Airless Spray, 2-1 ratio (includes hose, gun, extension  
and tip

Air Powered, liquid pressure cleaning pump (underbody and fenders)

Blast cleaning machine (For removing rust and foreign deposits)

\*Apron, vinyl coated fiberglass

\*Gloves, oil and chemical resistance

\*Respirator, air filtering, pad type

\*Brush, aluminum wire

\*Brush, stainless wire

\*Brush, fiber

\*Goggles, safety plastic

The T/A 457 document will reflect all items listed above except those prefixed by an asterisk. Items of this type are not normally afforded T/A

application as they are expendable, local purchase, commercial off-the-shelf type equipment and are not EAID (equipment authorization inventory data) accountable.

B. The vehicle undercoater material (formally Grade 1) required for implementing instructions in this publication is a QPL item in accordance with Specification MIL-C-00-83933A (MR) and can be obtained by formal requisitioning policy/procedure. U.S. Rust Control Corp., 2100 N.W. 17th Ave., Miami, FL 33142, products or equal, are to be used for coating the exterior body surface, radiators and electrical systems (formally Grades 2, 3, and 4) and must be obtained through local purchase procedures. Each type of these FSC 8030 materials is contained in either a one gallon can, five gallon can or 55 gallon drum.

MATERIAL	APPLICATION	EST QTY FOR FIRST TREATMENT
MIL-C-0083933(MR) (Formerly Grade 1)	Vehicle undercoater including under side of hood, inside doors, rocker panels, door posts, inside trunk lid, etc.	6 qts
U.S. Rust Control XP 400 or equal (Formerly Grade 2)	Exterior seams, joints and body surface, behind mouldings, chrome strips, window trim and other hard to reach areas.	3-4 qts
U.S. Rust Control XP700A and XP700B or equal (Formerly Grade 3)	Radiators Exterior	1 pt
U.S. Rust Control XP300 or equal (Formerly Grade 4)	Electrical System Components	1 pt

NOTE:

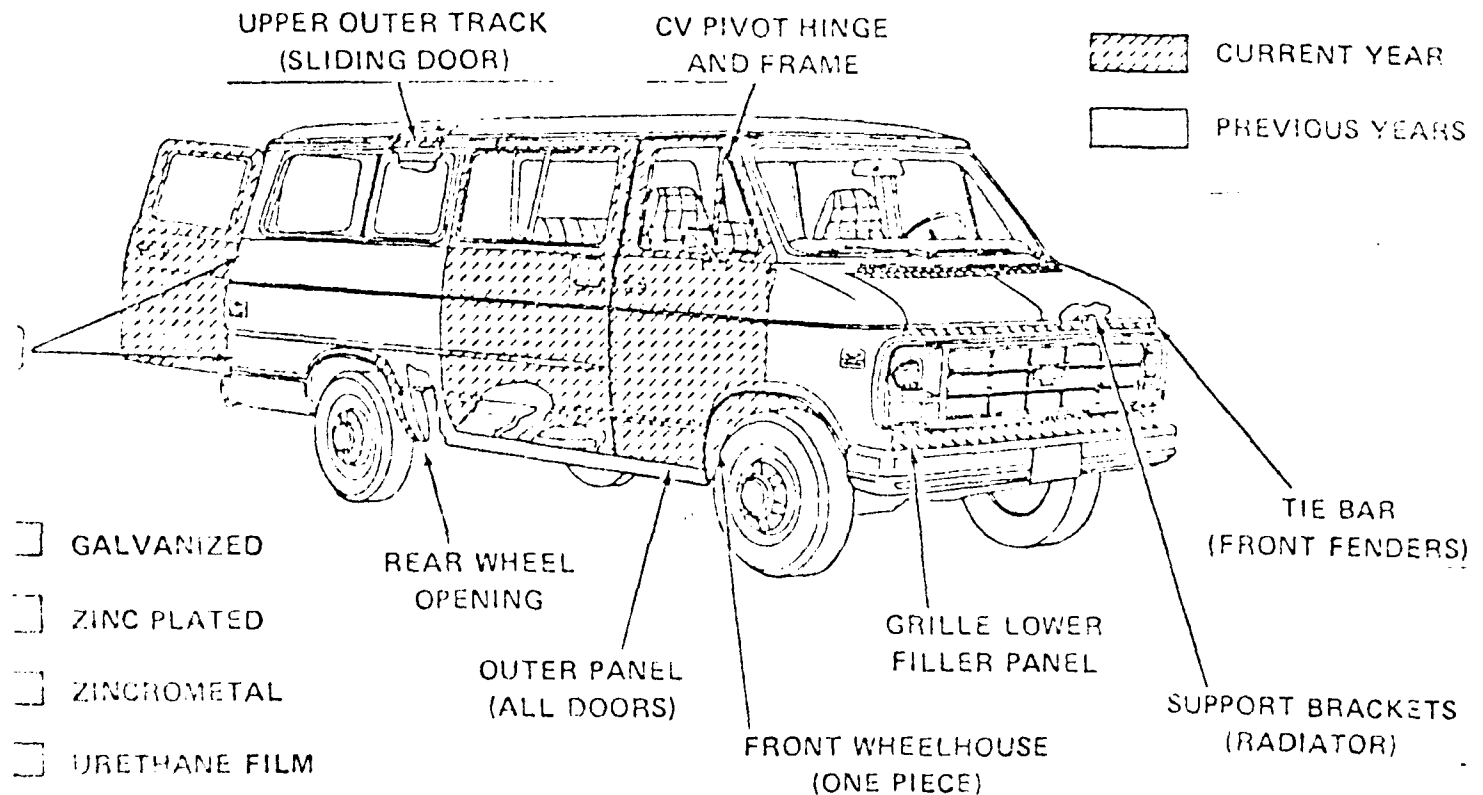
References to Formerly Grades 1, 2, 3 and 4 under this paragraph are to identify Section II areas of application.

C. Requirements can be computed from usage/application data listed below.

MATERIAL	APPLICATION	EST QTY FOR FIRST TREATMENT
Grade 1	Vehicle undercoater, including underside of hood, inside doors, rocker panels, door posts, inside trunk, trunk lid, tail gates etc.	6 qts
Grade 2	Exterior Body surface, exterior seams, joints, behind moulding, chrome strips, window trim and hard to reach areas.	3-4 qts
Grade 3	Radiators (exterior)	1 pt
Grade 4	Electrical System Components	1 pt

# 1978 CHEVROLET G TRUCK



## CORROSION PROTECTION

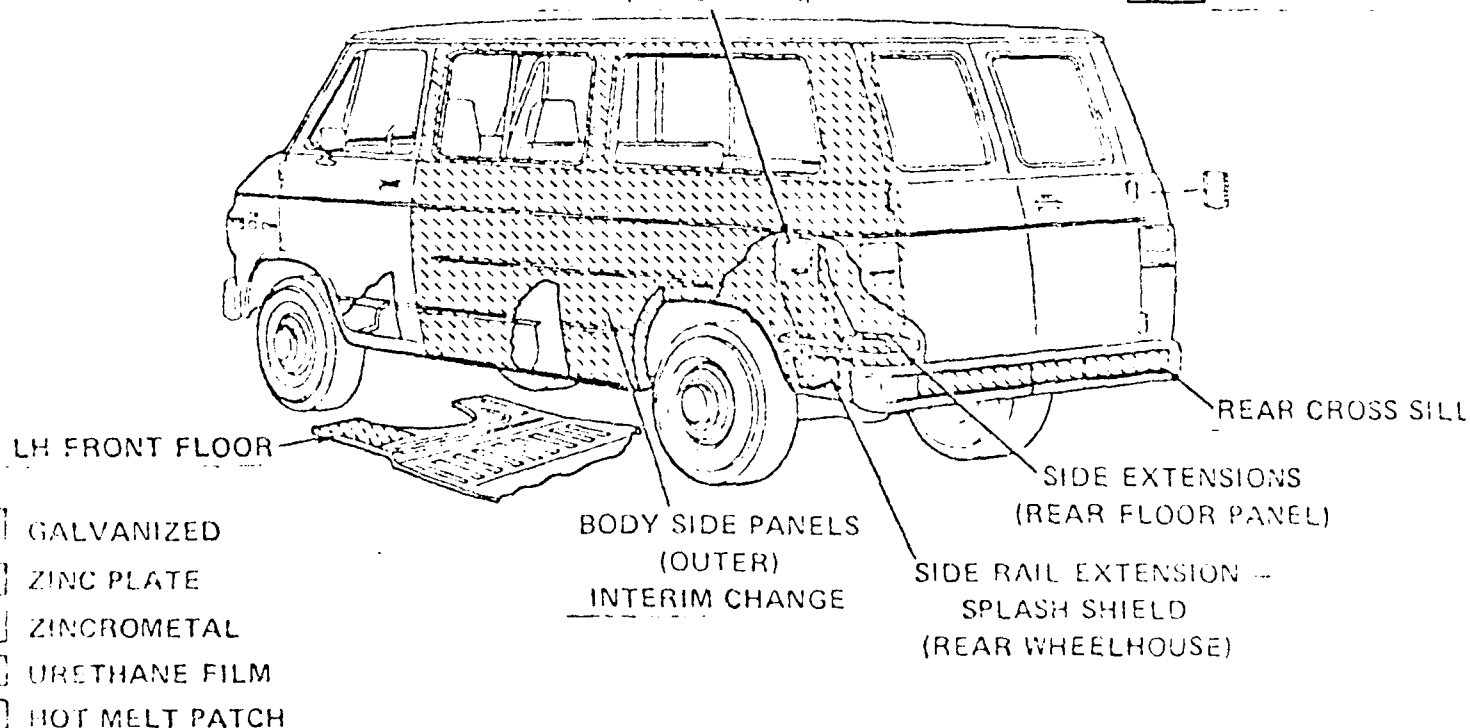


# 1980 CHEVROLET G TRUCK

## CORROSION PROTECTION

FILLER NECK HOUSING  
(FUEL TANK)

 CURRENT YEAR  
 PREVIOUS YEARS

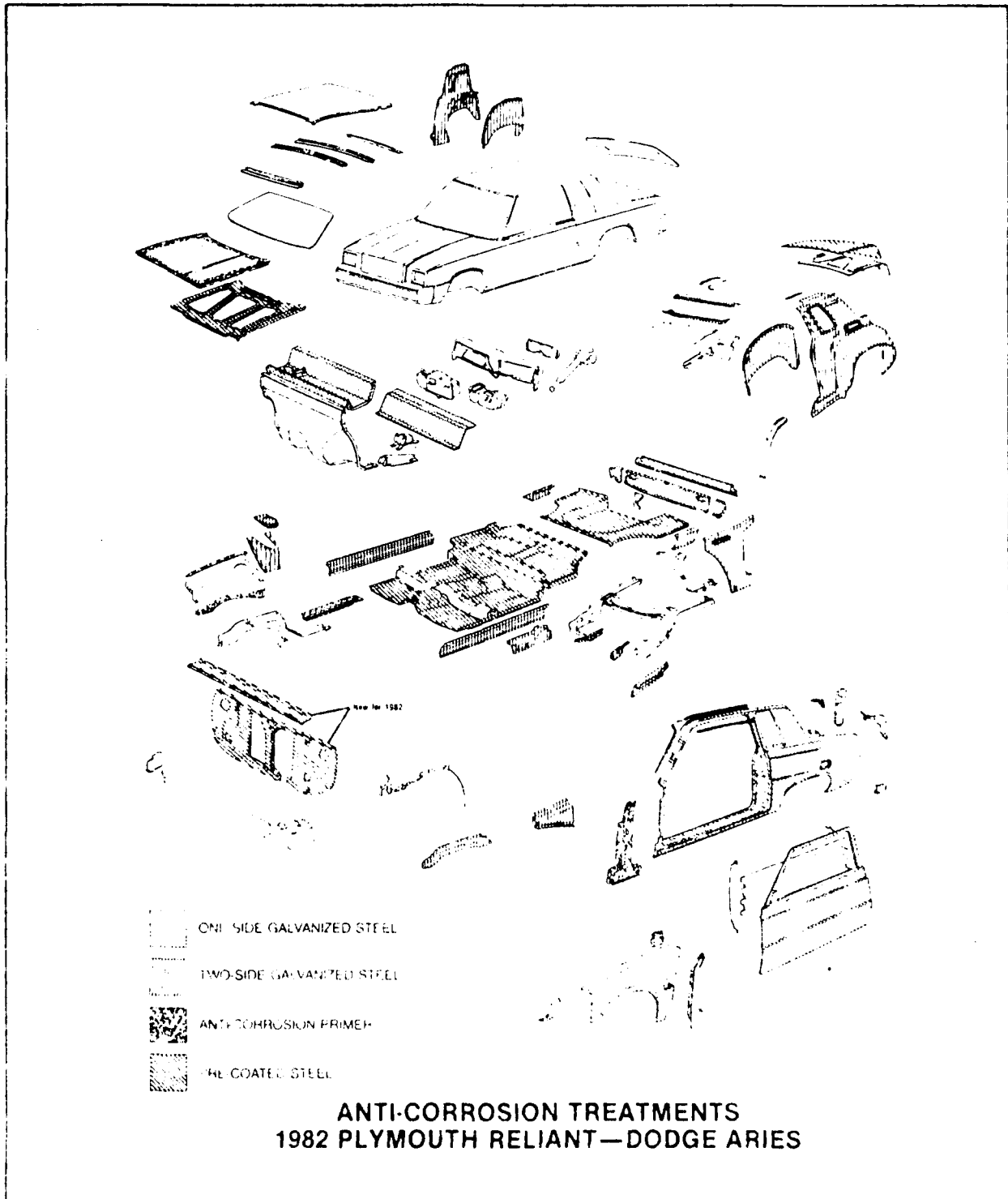


## BODY

### Corrosion Protection

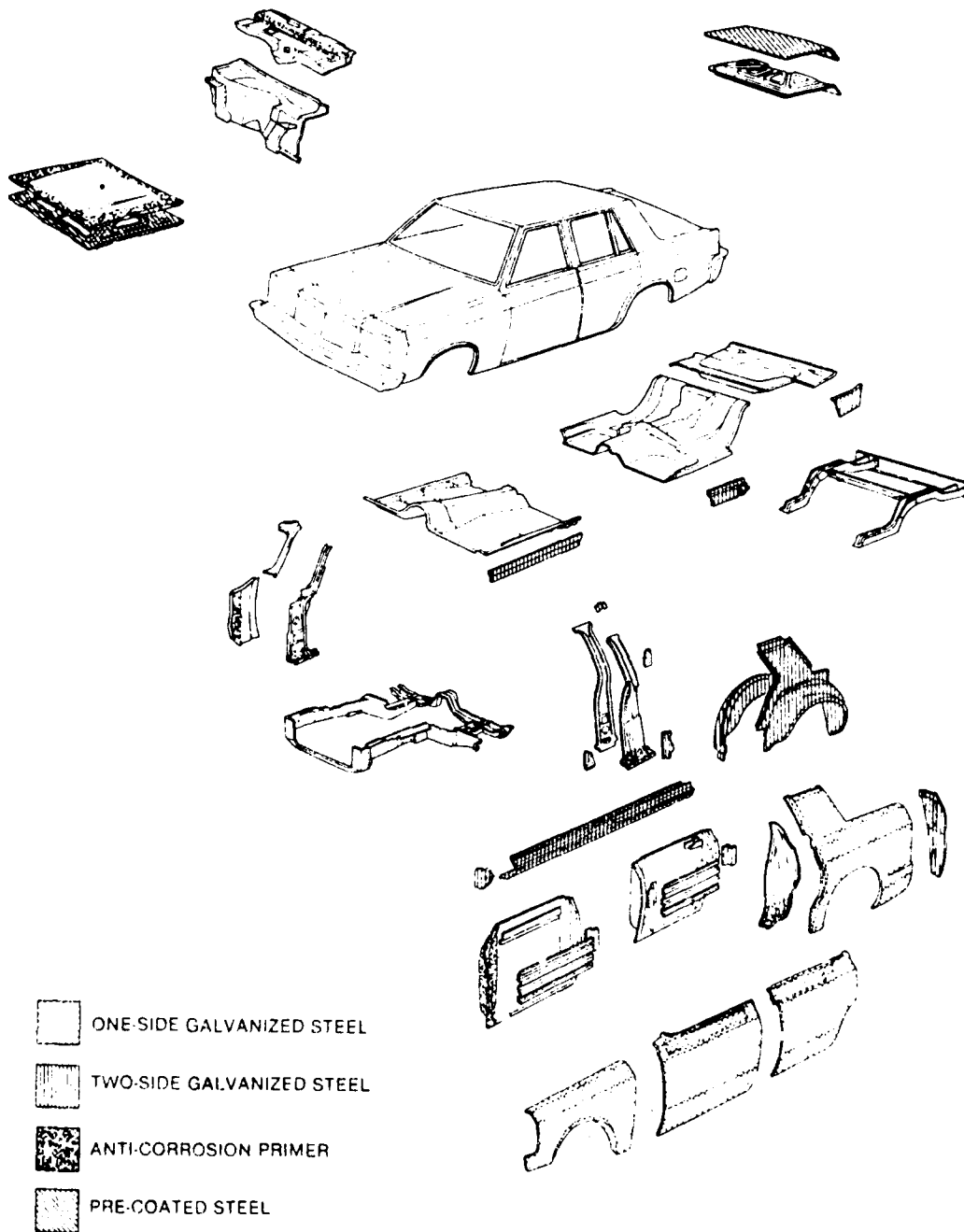
Corrosion protection of all 1982 models has been improved. Various additional anti-corrosion treatments are being used, including the

expanded use of steel that is pre-coated with a zinc-rich primer which retains its integrity after forming or stamping.



Atch 5

# BODY



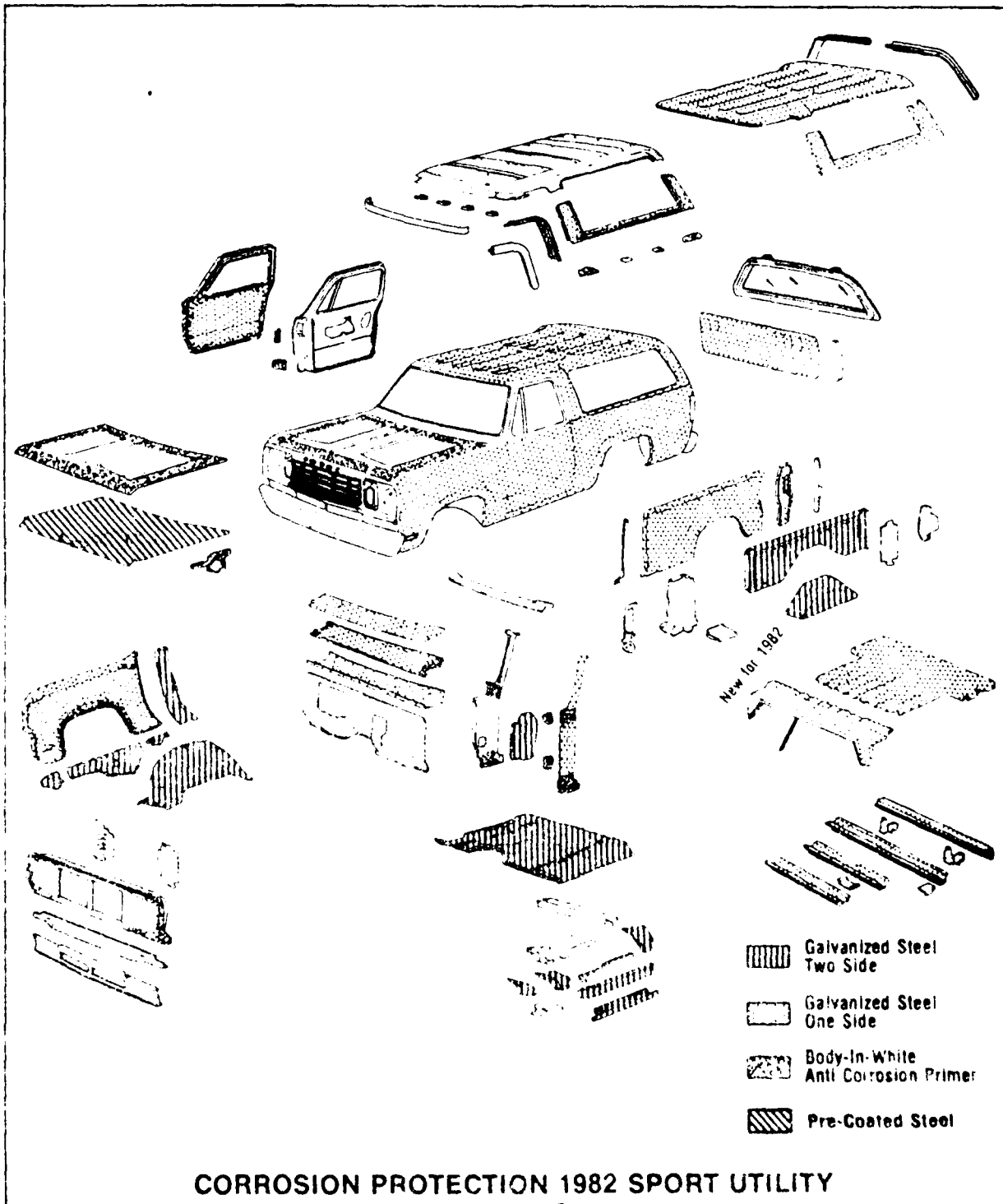
**ANTI-CORROSION TREATMENTS  
1982 DODGE DIPLOMAT, PLYMOUTH GRAN FURY  
AND CHRYSLER NEW YORKER**

## BODY

### Corrosion Protection

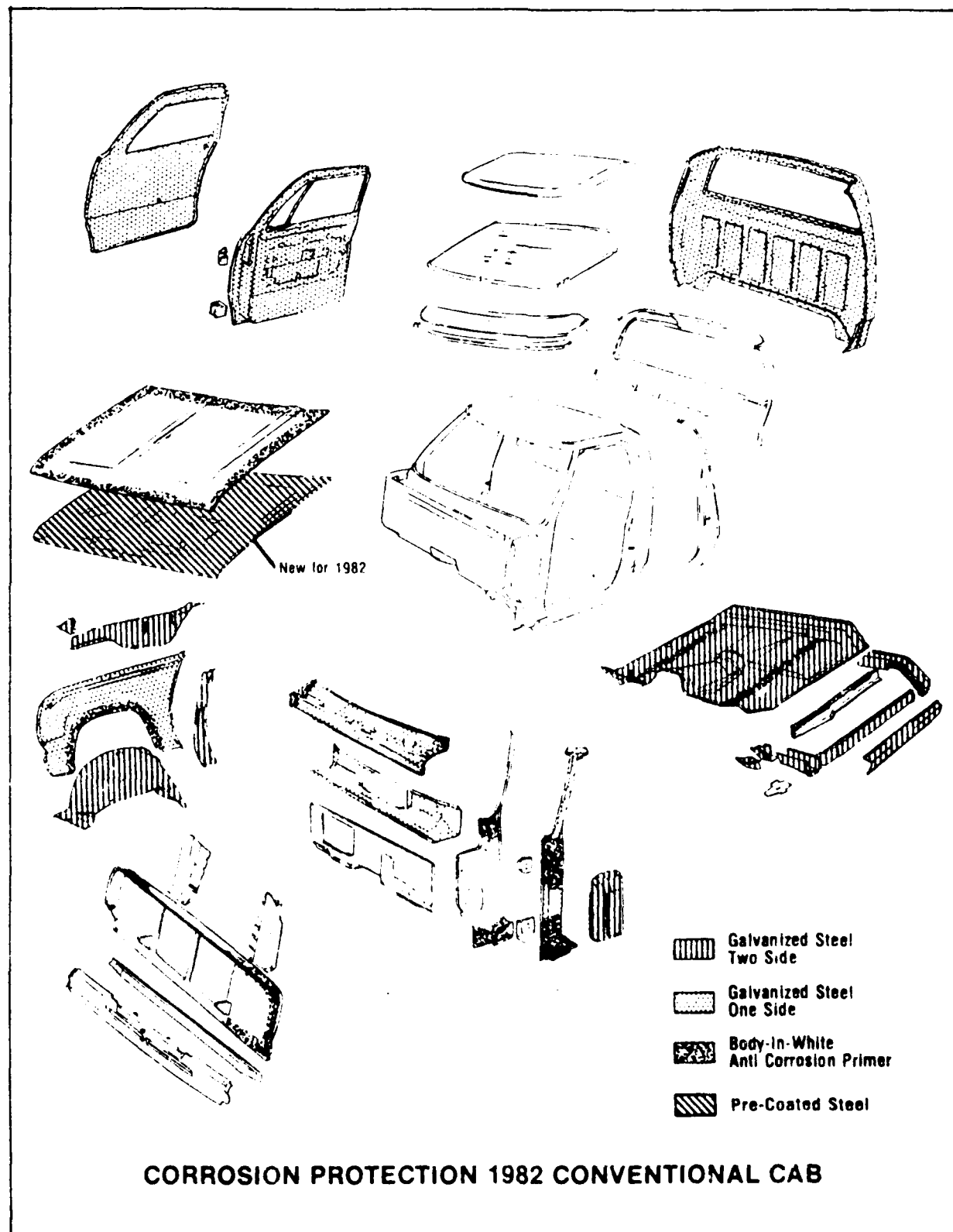
Corrosion protection of most 1982 model trucks has been improved. Various additional anti-corrosion treatments are being used, in-

cluding the expanded use of steel that is pre-coated with a zinc-rich primer which retains its integrity after forming or stamping.

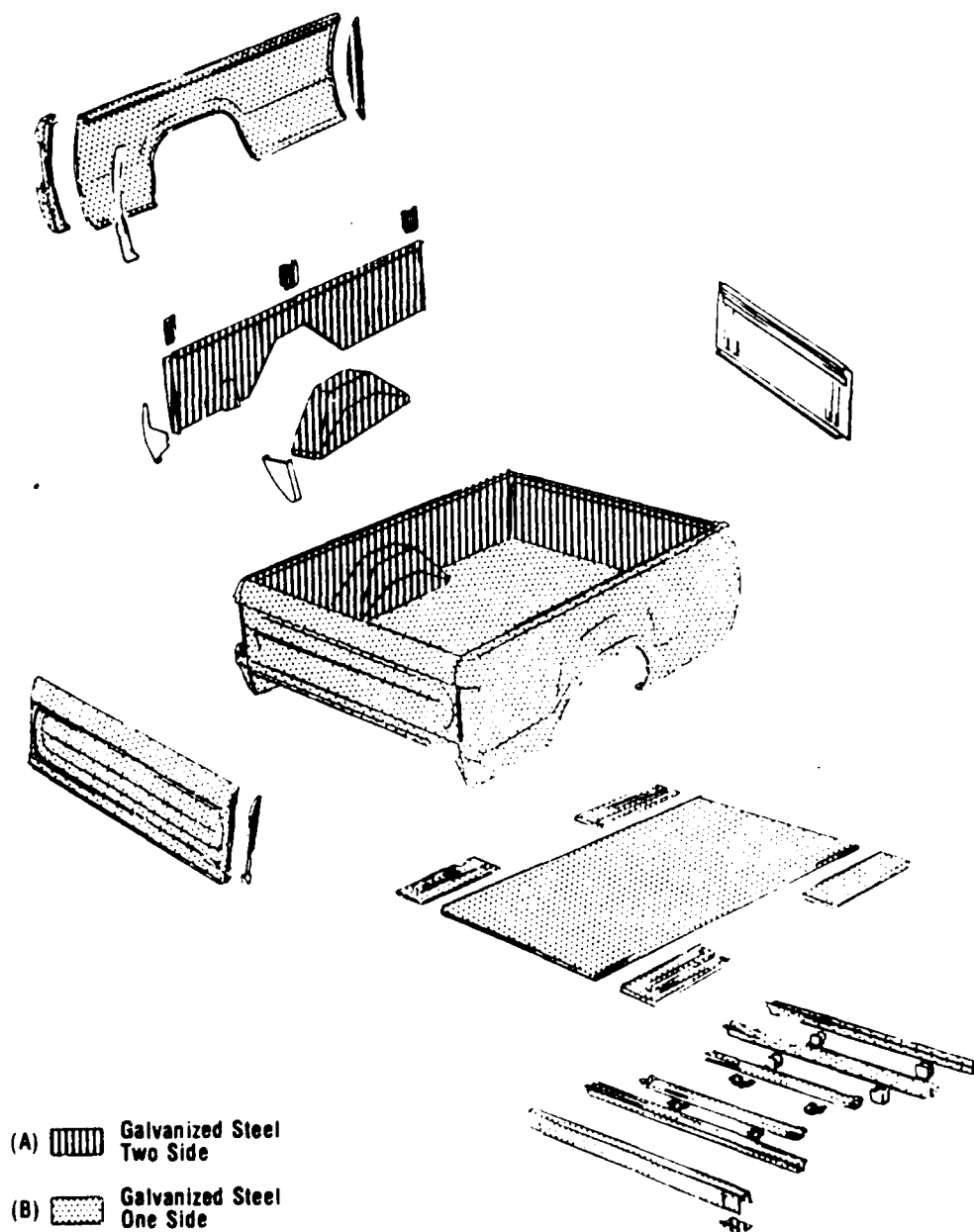




# BODY



# BODY



CORROSION PROTECTION 1982 SWEPTLINE BOX

**INTERNATIONAL HARVESTER**

February 2, 1982

WRALC

Robins AFB, GA 31098

Attention: Col. Harris, MMI

Subject: DCSC, Columbus, Ohio Invitation for Bid No. DLA700-81-B-1397 Covering  
Rubber-tired, Front End Scoop Type Loaders  
(MIPR Nos. FD2060-81-98015 and FD2060-82-56440)

We are greatly concerned about the incorporation of the requirement for Rustproofing per MIL-STD-1223 into the subject procurement covering thirty-two (32) 2½ cubic yard size and twenty-four (24) 2½ cubic yard size rubber-tired articulated scoop type loaders.

We are both perplexed and dismayed that this rustproofing requirement is being proposed for application on heavy duty off-highway construction equipment of this type.

The articulated vehicles being procured by the Air Force are commercial construction equipment as furnished in the commercial marketplace. Rustproofing as dictated by the above-referenced specification or in any form, is not a commercial requirement for this type of equipment. As far back as we can trace, articulated loaders have never been rustproofed, certainly never at one of our factories. Our distributor organization further substantiates that rustproofing is not performed in the field for construction equipment of this type.

Obviously, in view of the preceding statements, construction equipment manufacturers or distributors do not have rustproofing facilities, equipment and trained personnel to provide this service. Furthermore, a rustproofing specialty house (such as Ziebart) who specialize in rustproofing automobiles would not be able to fully comply with this military requirement as it is presently prepared. Disassembly of numerous heavy components, approvals to drill holes, the need to develop special tools, procedures, etc. would cause severe equipment delays. Obviously, manuals describing the procedure to be followed are not available since there have not been any previous rustproofing experiences with this type of equipment.

At this point you might ask the question: "Why isn't rustproofing performed on heavy-duty construction equipment?" The answer is that there is no plausible advantage in incorporating a rustproofing requirement into the specifications for construction type equipment. The applicational and environmental conditions under which construction equipment of this type is used dictate that the equipment be very sturdily built. This additional material strength and thickness is dictated by the fact that the underside of this equipment is constantly in contact with dirt, mud, rocks, shrubbery, tree stumps, etc. Furthermore, the cabs and sheet metal must, by necessity, be built sturdier to withstand the applicational shocks and vibrations normally experienced by this equipment. This in itself assures that the materials and sheet metal thicknesses and strengths are such that "rusting through" is not a problem.

WRALC

Attn: Col. Harris

Page 2

February 2, 1982

We sincerely appreciate our relationship with the U.S. Air Force and are greatly concerned that the incorporation of this "rustproofing" requirement will prevent us from submitting a responsive offer regarding the subject loader procurement.

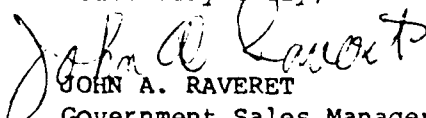
We are certain that all other loader manufacturers are in a similar situation. We understand that other manufacturers have already contacted the Government expressing their concern with this requirement. Previously, in matters of this type, the U.S. Air Force has coordinated the proposed specification with industry (the various construction equipment manufacturers). This was not done in this instance.

We understand that at the request of the Air Force Staff, a study is presently being conducted by the Logistics Management Center, Gunter Air Force Station, Alabama, concerning the feasibility and desirability of rustproofing air force vehicles including construction type off-highway equipment.

In view of the above circumstances, we believe that it would be in the best interest of the Government that all reference to "rustproofing" be deleted from this solicitation, as well as, deferred from inclusion in future pending procurements for construction equipment or aircraft towing tractors until such time that the Air Force Study has been completed and industry coordination has occurred.

We would appreciate your willingness to review this matter. We believe that your efforts will be beneficial to all parties involved including the Air Force.

Yours very truly,

  
JOHN A. RAVERET  
Government Sales Manager

/ms

cc: WRALC  
Robins AFB, GA 31098  
Attn: Ben Simpson, ALC-MMIRAB

AFCEC  
Tyndall AFB, FL 32401  
Attn: Mr. Lee R. Munroe

Defense Construction Supply Center (DCSC)  
Directorate of Procurement and Production  
Columbus, OH 43215  
Attn: Mr. David Johnson, DCSC-PCCD

Headquarters USAF/LETN  
Pentagon  
Washington, D.C. 20330  
Attn: Mr. Frank Colson

Air Force Logistics Management  
Center/LETC  
Gunter Air Force Station  
Alabama 36114  
Attn: Captain Dan King/LETC

## DEERE & COMPANY

JOHN DEERE ROAD, MOLINE, ILLINOIS 61265, U.S.A.



1 February 1982

Captain Daniel King  
AFLMC/LGT  
Gunter Air Force Station, AL 36114

Dear Captain King:

Please refer to our phone conversation regarding the Air Forces' decision to require rustproofing in accordance with MIL-STD-1223U on all vehicles, including construction equipment. We currently have solicitation DLA700-81-B-1397 for fifty-six (56) four wheel drive loaders (scoop type) that contains this requirement.

It is our opinion that this is an inane requirement for construction equipment and is being confused with preservation requirements for shipping and storage. Construction equipment is, by its nature, made of heavy materials designed to work the earth and brave the elements. Because of the work that these machines do, it is impossible to prevent paint and other surface protections from being worn off. (This would include rustproofing)

We feel that rustproofing will add very little to the life of a piece of construction equipment and would be very costly. Our initial estimate is about \$600 per unit for the loaders mentioned above. In addition, this requirement would necessitate our "farming" this work out to a "Ziebart" type company since our company as well as other construction equipment manufacturers does not have the trained personnel or the equipment to do this rustproofing. In this respect you are in direct contradiction with the "buy commercial" philosophy dictated by the federal specifications under which you are buying this equipment.

We would be interested in knowing if the Air Force has substantiated this requirement. In other words, have you conducted studies that indicate cost savings due to prolonged life of construction equipment because of rustproofing? As tax payers we would like to think that the Air Force

**DEERE & COMPANY**

Captain Daniel King

1 February 1982

Page 2

can justify this additional cost. We feel that it would be a real waste of tax payers' money to adopt this "across the board" requirement without adequate studies on specific types of equipment.

We would appreciate being kept informed of the progress of your survey.

Cordially yours,

  
R. J. Green, Manager  
Government Contracts

RJC/dka

C: B. R. Retzlaff, Manager  
National Sales Division  
Deere & Company

ROUTINE

PT 00069

343/0125Z

PAGE 01

106 02

SECTION

INFO

ITUZYUW RUEAHQA7803 3430122-0000--RUEO 000

ZNR 00000

R 081945Z DEC 81

FM HQ USAF WASHDC //LETT//

TO RUVAFLC/HQ AFLO WPAFB OH//LOZ//

AMVRAAA/WRALC ROBTNS AFB GA//DSP/MM//

INFORMA/USAF WPLO BAYONNE NJ//LOZ//

RUCLEVA/USAF WPLO NEW ORLEANS LA//LOZ//

AMFRAAE/HQ USAFE RAMSTEIN AB GE//LGT//

INFO RUKOMTC/HQ MTRC WASH DC//MT-IT//

RUEAHQA/HQ USAF WASHDC //LETT//

BT

UNCLAS

SUBJ: DECK LOADING OF AIR FORCE VEHICLES

REFS: A. THOAFLO/LOZ MSG, 141600Z SEP 81

B. HQ USAFE/LGT MSG, 200909Z OCT 81

C. HQ AFLO/LOZ LTR, 10 NOV 81

D. TELECON G. IDAR, HQ USAF/LETT AND AL RUIS, HQ  
MTRC/MT-IT, 24 NOV 81

1. REFERENCE A ADDRESSED AN OPERATION LISTENING POST VISIT BY  
AFLO/LOZ TO HQ USAFE IN JUL 81. USAFE STATED AF VEHICLES WERE  
BEING DECK LOADED IN CONUS TO USAFE. AFLO ASKED FOR SPECIFICS.

PAGE 02 RUEAHQA7803 UNCLAS

REFERENCE B, HQ USAFE PROVIDED INFO FROM BUTTERFIELD. REFERENCE C,  
HQ AFLO/LOZ REQUESTED HQ USAF ASSISTANCE. REFERENCE D, HQ  
USAF/LETT COORDINATED WITH HQ MTRC/MT-IT.

2. HQ MTRC/MT-IT, MR. AL RUIS STATED IT WAS POLICY NOT TO DECK  
LOAD CARGO UNLESS COORDINATED WITH THE SHIPPER OFFICES. HOWEVER,  
IN THE CASE OF THE EIGHTEEN LOW BOYS, MTRC AUTHORIZED DECK LOAD-  
ING BECAUSE EQUIPMENT DID NOT HAVE SELF PROTECTED EQUIPMENT.  
MTRC, WASH DC/MT-IT, BY MSG 021700Z DEC 81, DIRECTED THAT AREAS  
THAT COORDINATION MUST BE ACCOMPLISHED IN ALL CASES EVEN WHEN ON-  
DECK STOWAGE OF A COMMODITY IS CONSIDERED NORMAL PROCEEDURE."

ROUTINE

Atch

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Capt  
12/9

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HTE-IT  
(MR. B.H.)

00111

ADVISE HQ USAF/LETT OF ANY FUTURE INFRACTIONS ON DECK LOADING  
OF AF VEHICLES WITHOUT COORDINATION WITH SHIPPER SERVICE.

1

7803

0000

ROUTINE



UNCLASSIFIED

PENTAGON TELECOMMUNICATIONS CENTER

PTTUZYUW RUKGNMA1605 3361820

PRIORITY

P 021700Z DEC 81

FM CDRMTMC WASHDC //MT-IT//

TO RUEOBMA/CDRMTMCEA BAYONNE NJ //MTE-IT//

RUWADMA/CDRMTMCWA OAKLAND CA //MTW-IT//

RUDOROA/CDRMTMCTTCE ROTTERDAM NETHERLANDS //MTC-SPO//

INFO RULSWCA/COMSC WASHDC

RUEAHQA/HQ USAF WASHDC

DA-BHCSVD

BT

UNCLAS

SUBJECT: ON-DECK STOWAGE

A. CDRMTMC, MT-IT, MSG 042030Z OCT 79. SUBJ: MSC BILLING PROCEDURES (NOTAL).

1. REF MSG ADVISED THAT MTMC POLICY CONCERNING SUBJECT STOWAGE WAS THAT ALL ON-DECK STOWAGE OF CARGO WAS TO BE COORDINATED WITH THE SHIPPER SERVICES.

2. BE ADVISED THAT COORDINATION MUST BE ACCOMPLISHED IN ALL CASES, EVEN WHEN ON-DECK STOWAGE OF A COMMODITY IS CONSIDERED "NORMAL" PROCEDURE.

BT

ACTION

INFO DA(1) LET(2) OPR AMT 79(0) FILE CY(1)

(U, F)

MCN=81336/18433

TOR=81336/19422

TAD=81336/2016Z

CDSN=MAP850

\*AIR FORCE MESSAGE\*

PAGE 1 OF 1  
021700Z DEC 81

TRS 2-1

12 12 1981

LOZ/C/Col Cross/76435/9 Nov 81/vh  
Deck Loading of Air Force Vehicles

HQ USAF/LET

1. References:

a. HQ AFLC/LOZ Msg 14/1600Z Sep 81, Subject: Deck Loading of Air Force Vehicles (Attachment 1)

b. HQ USAFE/LGT Msg 20/0909Z Oct 81, Subject: Deck Loading of Air Force Vehicles (Attachment 2)

2. During a recent Operation Listening Post visit by members of this command to USAFE, personnel from USAFE/LGT complained that some AF vehicles bound for European destinations were being deck loaded aboard ships transiting MTMC ports. The contention was that these vehicles are sustaining damage from heavy seas and prolonged exposure to the elements. In order to investigate this claim, we requested USAFE to provide more specific information that could substantiate instances of such deck loading. Their reply is at Attachment 2.

3. In correlating their reply with data available to our New Orleans WPIO, we found the following about the two voyages which departed Mobile: On Voyage A5397, the only vehicles on the top deck were eighteen low-boy trailers, approved for top deck stow by MTMCIA. The other vehicles -- four forklifts and two sweeper trucks -- were on the Number Two deck. On Voyage #5675, the two low-boy trailers were also on Number Two deck. Since USAFE's reply indicates that MSC Bremerhaven and HQ MTMC Rotterdam are unaware of any restrictions on deck loading of vehicles (other than POVs), it is possible that some AF vehicles are being transferred to the top deck at some enroute ports of call.

4. Further investigation revealed that past policy -- or understanding -- between MTMC and USAF did not permit deck loading of our vehicles. Any deviation from this policy was permitted only with prior approval of the appropriate USAF WPIO. However, we are told by cognizant personnel here at HQ AFLC, at WR-ALC/DS and MM, and at our WPIOs that current directives do not cover a deck loading policy for AF vehicles. It would appear the latest guidance on this subject was in HQ USAF message AFSTP 9411C, 23 November 65, subject: Deck Loading of Cargo, addressed to Commander, Military Traffic Management and Terminal Service (MTMTS). That message delegated the responsibility for authorizing deck loading of certain items of cargo, except uncatered aircraft, to the USAF WPIOs.

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5. To clarify the situation and to prevent future incidents, we recommend that an updated message be addressed to HQ MTMC and COMSC reiterating Air Force desires concerning deck loading of its vehicles. We believe there is a need to reaffirm a position that our vehicles should not be loaded on the top deck unless extenuating circumstances prevail, such as too large for the hold, or by not loading on the top deck, there would be an unreasonable amount of time awaiting the next sailing. Deviations or exceptions such as these would only be permitted with prior approval of the appropriate USAF WPLO.

6. Your assistance is appreciated.

FOR THE COMMANDER

DAVID E. BEEGLE  
Deputy Director of Distribution  
Office of DCS/Logistics Operations

2 Atch

1. LOZ Msg 141600Z Sep 81
2. USAF Msg 200909Z Oct 81

*Copy to: USAFE/LGT*

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HUNT 141200  
311208

TR5-2

HQ USAFE RAMSTEIN AB GE//LGT/LGS//

SUBJ: DECK LOADING OF AIR FORCE VEHICLES

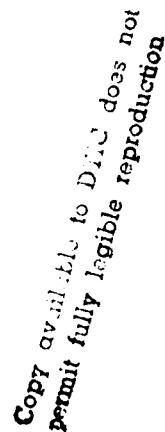
3. IN ORDER FOR US TO PURSUE THIS MATTER WITH HQ MTMC, REQUEST YOU PROVIDE SPECIFIC INFORMATION PERTAINING TO INSTANCES OF DECK LOADING OF AIR FORCE VEHICLES, I.E., TCN, VOYAGE NUMBER, VESSEL RECEIVED ON, ARRIVAL DATE OF VESSEL, POE, POD, TYPE VEHICLE, WATER COMMODITY CODE, DAMAGE SUSTAINED. ANY OTHER INFORMATION HELPFUL IN OUR INVESTIGATION WOULD BE MOST APPRECIATED.

LOZCW/76435/MAJ OSBORNE/09 SEP 81/VH

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## BY OPERATING COMMAND " & MAJOR TENANT COMMANDS





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VEHICLE RUSTPROOFING GUIDE  
FOR VEHICLE MAINTENANCE MANAGERS

The following questions should be considered when determining the requirement/level for vehicle rustproofing:

- Does the climate or geographic location create an abnormal incidence of corrosion?

- located near the seacoast/salt water (within 5 miles)

- located in an area that experiences significant road salting

- Will the vehicle be operated/stored under cover/indoors?

- How will the vehicle be used?

- Will it haul corrosive materials (urea, salts, etc.) on a recurring basis?

- Will it be used to conduct construction or clean-up work in direct contact with salt-water or other corrosives?

- Will it travel salted roads or will it spend the majority of its time in a salt-free environment (example - flightline or perhaps on-base when base does not salt roads even if local community does)?

- How is the vehicle constructed?

- Are there numerous enclosed panels that can hold moisture?

- Is there significant use of thin guage steel, untreated during the manufacturing process?

- Have vehicles of this type historically required extensive corrosion repair?

-- Was previous corrosion repair for rust through or surface corrosion?

-- Were previous vehicles used/stored in the same manner this vehicle will be.

- Will the cost to rustproof this vehicle be a good investment over the period of remaining life?

-- What is the current age of the vehicle?

-- What is the vehicle's life expectancy?

-- How many years do you expect the vehicle to last mechanically?

- Which will be the most cost/time efficient method of treatment?

-- In-house maintenance?

-- Local contract?

- If rustproofing is required, how extensive a treatment is required?

-- Undercoating

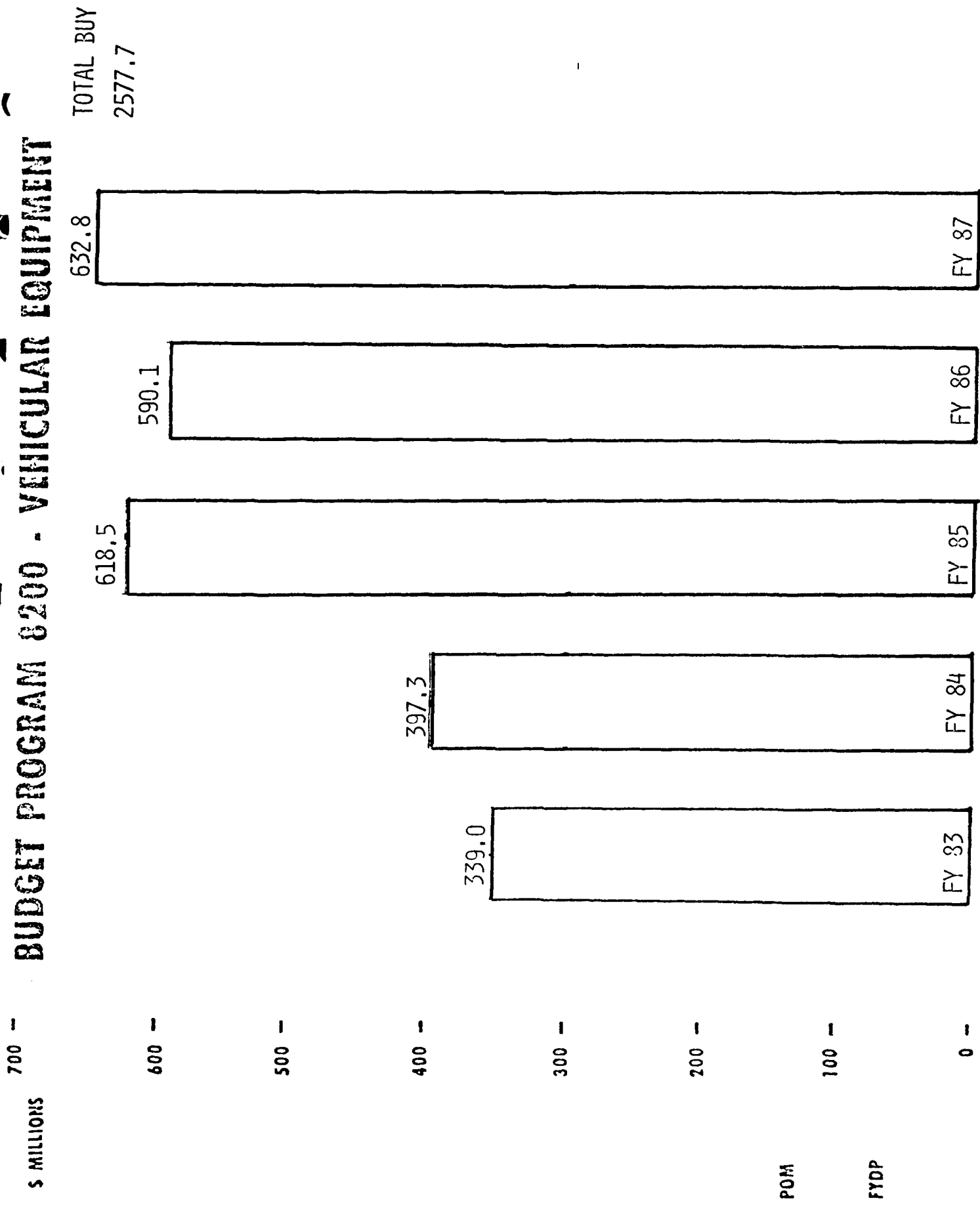
-- Type A

-- Tropical

-- Other



BUDGET PROGRAM 8200 - VEHICULAR EQUIPMENT



EQUIPMENT NECESSARY FOR  
VEHICLE RUSTPROOFING

<u>ITEM</u>	<u>QTY</u>	<u>COST</u>
PUMP	1	\$710.
GUN	1	217.
WAND 18" RIGID	1	20. Approx.
WAND 48" RIGID	1	30. Approx.
WAND 36" FLEXIBLE	1	40. Approx.
WAND TIP 180	1	10. Approx.
WAND TIP 360	1	10. Approx.
WAND TIP 180 REVERSE SPRAY	1	10. Approx.
	TOTAL	<u>\$1047.00</u>

PLASTIC PLUGS 10/VEH @ 32¢



**SYSTEMS  
RESEARCH  
LABORATORIES  
INC.**

DEVELOPMENT OF RINSE INHIBITOR

M. Khobaib

February 11, 1982

Research Applications Division  
Systems Research Laboratories, Inc.  
2800 Indian Ripple Road  
Dayton, OH 45440-3696

## SECTION 1

### INTRODUCTION

A borax-nitrite-base inhibitor has been developed for incorporation into the Air Force Rinse Facility operation at MacDill Air Force Base in Florida. The laboratory and field tests have demonstrated its effectiveness in preventing corrosion of aircraft structures in chloride-contaminated water containing up to 1000 ppm chloride ions. Recently this formulation has been improved to inhibit corrosion of most metallic parts in more aggressive solutions and can be used even in a 3.5% NaCl solution.

Although this inhibitor is currently being used in various applications at several Air Force bases, there has been some problem with data tracking. It is suggested that the improved formulation be incorporated into the Rinse-Facility operation and a detailed program be set up for tracking of data. A quantitative analysis of corrosion-maintenance data will establish the cost saving achievable by inhibited wash of Air Force aircraft and vehicles.

## SECTION 2

### BACKGROUND

Corrosion costs the United States billions of dollars each year. The annual maintenance cost for military aircraft alone is several billion dollars, most of which is related to corrosion. Various approaches can be taken in attempts to minimize these tremendous costs. Two common corrosion-prevention methods utilize protective coatings and inhibitors.

Several years ago, a study conducted by the U. S. Navy on corrosion prevention in carrier-based aircraft revealed that by merely rinsing the aircraft with water to remove detrimental particles such as salt and ash, a considerable savings could be realized in terms of corrosion maintenance. By late 1975, the U. S. Air Force had made a decision to build a rinse facility for the F-4 aircraft and to install it under AFLC/WRALC and TAC at MacDill Air Force Base in Tampa, Florida. At the corrosion managers conference at WRALC in the fall of 1975, questions concerning hard-water rinsing as opposed to inhibited- or demineralized-water rinsing were raised. In rinsing aircraft, there is a good possibility that water will be trapped in crevices or so-called dry-bay areas and that trapped hard water will cause serious corrosion problems, completely jeopardizing any advantage which hard-water rinsing may have had as a corrosion-control method. Therefore, incorporation of a low concentration of a nontoxic water-soluble inhibitor into the Rinse Facility was suggested. A contract was awarded by the Air Force Materials Laboratory to Systems Research Laboratories, Inc. (SRL), for the development of a water-soluble nontoxic inhibitor for use in the Rinse Facility at MacDill Air Force Base.

## SECTION 3

### DEVELOPMENT OF INHIBITOR FORMULATION

As a result of extensive research efforts, a multi-functional corrosion inhibitor was prepared from a series of compounds which are nontoxic and soluble in aqueous solution to provide low-cost corrosion protection for a broad spectrum of metallic structures. The multi-functional inhibitor formulations are a combination of cathodic and anodic inhibitors which retard the rate of both cathodic and anodic reactions at the corroding surface and are effective in retarding environmental attack in localized areas such as corrosion pits and in crack propagation enhanced by environmental attack such as corrosion fatigue. The inhibitors are effective in low concentrations, thus providing low-cost protection, and they are environmentally safe for handling and deposition. Concentrations are nominally 0.3 to 0.5 wt.% in water.

In a later, more concerted effort, the inhibitor compound was modified for corrosion protection for a broad spectrum of metallic structures in very aggressive environments such as those containing high-chloride-ion concentrations (3.5 wt.% NaCl, e.g.). This was achieved through adding small amounts of selected surfactant compounds which--in combination with the basic inhibitor formulation--provide the added protection needed for preventing or significantly reducing corrosion in the presence of more aggressive environments.

The borax-nitrite-base inhibitor which was developed for incorporation into the Air Force Rinse Facility operation has provided excellent corrosion protection for aluminum, copper, and high-strength steels in normal as well as the chloride-contaminated water of the Air Force Rinse Facility. The effectiveness of the inhibitor was initially tested in the laboratory and the inhibitor was later incorporated into the Rinse Facility operation.

In Table I the representative results of tests with more than 400 different commercial and experimental formulations have been summarized and compared to uninhibited corrosion attack on several high-strength aluminum alloys used

TABLE I

## IMERSION TEST RESULTS

No. of Tests	Electrolyte	pH		Surface Appearance (Visual Observation)	Corrosion Rate (mpy)		Remarks
		Initial	Final		2024-T3	7075-T6	
1	5 Tap Water (WPAFB)	7.62	8.48	Stained; several pits.	Couple of oxide patches; several pits.	0.034 to 0.65	0.38 to 0.78 Should be inhibited.
2	5 Distilled Water	6.98	7.80	Entire surface attacked; lack of deep pitting.	Entire surface attacked; lack of deep pitting.	0.34 to 0.57	0.051 to 0.95 Should be inhibited.
3	5 0.1M NaCl in Distilled Water	6.95	7.50	Entire surface attacked; several pits.	Entire surface attacked; several pits.	1.38 to 1.98	1.54 to 2.4 Should be inhibited.
4	2 20% NaCl in Distilled Water	7.10	7.45	Entire surface attacked; several pits.	Entire surface attacked; several pits.	0.63 to 1.01	1.10 to 1.34 Should be inhibited.
5	3 0.035M (Sodium Borate + Sodium Nitrite) in Tap Water	8.95	8.90	Couple of dark patches; the other area lightly tinted.	Light tinted oxide all over.	0.071 to 0.23	0.31 to 0.51 Very poor inhibition.
6	3 NALCO 39L (18cc/liter) in Tap Water	9.24	9.00	Looks as original. Deposit at the bottom.	0-1% Deposit at the bottom.	$< 10^{-4}$ to $< 10^{-4}$	$< 10^{-4}$ to $< 10^{-4}$ Very good.
7	3 NALCO 41 (18 cc/liter) in Tap Water	7.14	6.98	Clean as original.	Couple of oily patches; otherwise, clean.	$< 10^{-4}$ to $< 10^{-4}$	$< 10^{-4}$ to $< 10^{-4}$ Good.



TABLE I (Cont'd)

## IMMERSION TEST RESULTS

No.	No. of Tests	Electrolyte	pH		Surface Appearance (Visual Observation)	Corrosion Rate (mpy)		Remarks	
			Initial	Final		2024-T3	7075-T6		
8	3	NALCO 26W (20 ppm) in Tap Water	9.05	8.92	Surface clean; several pea- size pits.	Entire surface attacked; shal- lower pit.	0.22 to 0.81	0.18 to 0.87	Very poor.
9	3	NALCO 918 (20 ppm) in Tap Water	8.62	8.46	Pits all over.	Pits all over.	0.34 to 0.96	0.38 to 0.74	Very poor
10	3	Betz 545 (500 ppm) in Tap Water	8.83	8.42	Corners and edges badly pitted; sur- face fairly clean.	Entire surface dark; several pits.	0.017 to 0.063	0.028 to 0.054	Poor.
11	2	Calgosil (2000 ppm) in Tap Water	8.50	8.40	Slightly dark scale all over; no visible pits.		0.010 to 0.18	0.13 to 0.15	Very poor.
12	2	Calgon Inhibitor CS (4000 ppm) in Tap Water	8.90	8.80	Light tinted scale all over; no visible pits.		0.067 to 0.088	0.083 to 0.092	Poor.
13	1	1% Sodium Dichromate in Tap Water	5.80	5.80	Surface looks as original.		< 10 <sup>-4</sup>	< 10 <sup>-4</sup>	Very good.
14	3	0.1% (Sodium Meta- silicate + Sodium Polyphosphate) in Tap Water.	8.64	8.45	Surface looks as original; lot of residue at the bottom.		< 10 <sup>-4</sup>	< 10 <sup>-4</sup>	Very good.

TABLE I (Cont'd)

## IMMERSION TEST RESULTS

No.	No. of Tests	Electrolyte	pH		Surface Appearance (Visual Observation)		Corrosion Rate (mpy)		Remarks
			Initial	Final	2024-T3	7075-T6	2024-T3	7075-T6	
15	3	0.035M (Sodium Borate + Sodium Nitrite) in Tap Water	8.95	8.90	Couple of dark patches; lightly tinted.	Light tinted oxide all over.	0.071 to 0.23	0.31 to 0.51	Very poor.
16	10	0.5% Sodium Borate + 0.05% (Sodium Nitrite + Sodium Nitrate) + 0.003% (Sodium Polyphosphate + Sodium Metasilicate) + 10 MBT in Tap Water	8.78	8.84	Surface looks as original.		$< 10^{-4}$	$< 10^{-4}$	Excellent.

extensively in the aerospace industry. Only Commercial Formulations 6 and 7 were acceptable in these tests. These, however, were later rejected because of their sensitivity to a narrow range of concentration for optimum effectiveness. At higher concentrations, these formulations attacked the alloy surface, which resulted in accelerated crack growth. This may have been due to the use of sodium hydroxide for maintaining a high pH value in solution. At lower concentrations the commercial formulations lost their effectiveness very rapidly, as compared to Inhibitor Formulation 16. Formulation 14 was not so effective in the presence of sodium chloride, and the mixture loses effectiveness with time. It is also less effective as a crack-growth inhibitor for high-strength alloys. Immersion tests were also carried out on high-strength 4340 steel, copper, cast iron, and brass to determine the broad basis of protection for metallic surfaces.

Galvanic-corrosion protection was determined by suspending pieces of high-strength aluminum and steel, copper, brass, and cast iron connected by a stainless steel rod and bolted with stainless-steel nuts in an inhibited-aqueous-solution electrolyte containing sodium chloride. The tests show excellent results for these metals for galvanic-corrosion inhibition using the multi-functional inhibitor system.

Sustained-load stress-corrosion-cracking and low-cycle corrosion-fatigue tests were also conducted to determine the effectiveness of the inhibitor formulations in the inhibition of environmentally enhanced crack-growth rates. The details of these tests have been reported previously. The corrosion-fatigue results for a series of runs for D6AC steel are shown in Fig. 1. The reproducibility for these specimens is quite good for fracture-toughness tests, and the results show that the inhibitors reduce the environmental effect to crack-growth rates in ambient air. Thus, the environmental effect has been inhibited in terms of the crack-growth rates in corrosion fatigue. The inhibitors are equally effective in the presence of 0.1M sodium-chloride solution. Similar effectiveness for the inhibitors is shown in Fig. 2 for 4340 steel [at two yield-strength levels: A - 210 ksi and B - 220 ksi and at different orientations T (transverse) and L (longitudinal) in the plate from which the test specimens were taken]. In Fig. 2 the air runs are not shown but are similar to those in the inhibited solution. In Fig. 3 the same elimination of the environmental effect has been

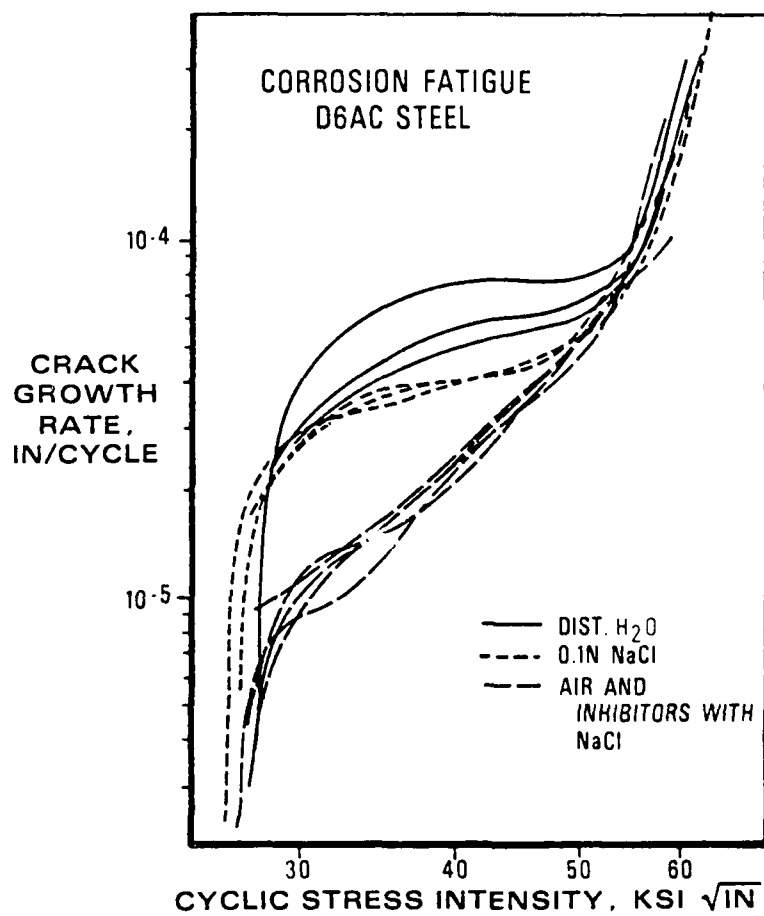


Figure 1. Corrosion Fatigue of D6AC Steel

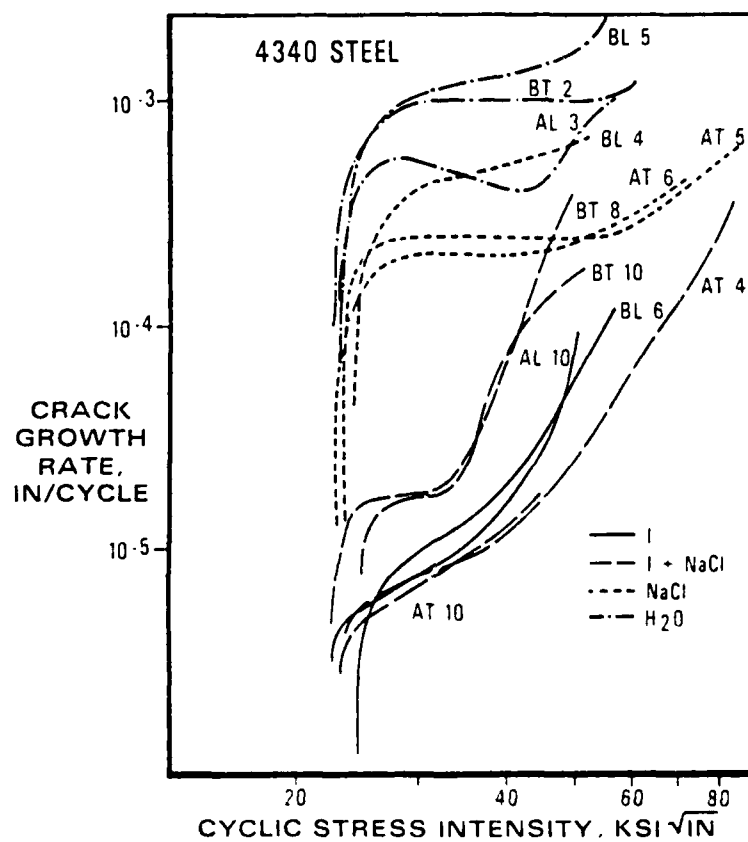


Figure 2. Corrosion Fatigue of 4340 Steel (A and B)

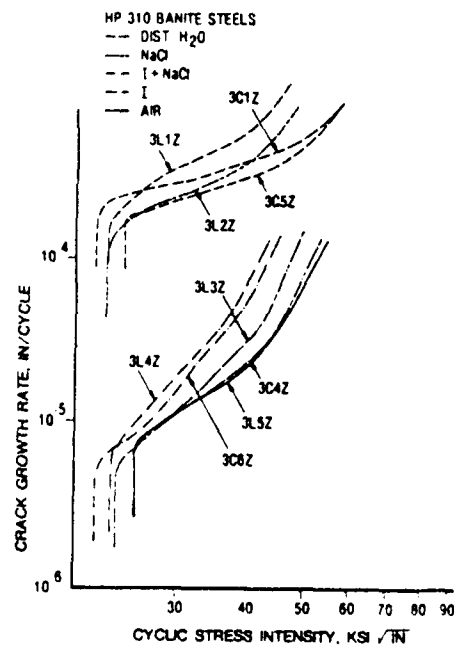


Figure 3. Corrosion Fatigue of  
HP310 Bainite Steel

shown for an experimental high-strength steel (Republic Steel) called HP310. In order to demonstrate the loss of effectiveness of chromate as a crack-growth inhibitor, some test results have been demonstrated quantitatively, as shown in Fig. 4. The crack-growth rate of D6AC steel was determined in chromate solutions with and without 0.1M sodium chloride. The loss of effectiveness can be seen in terms of an increased crack-growth rate with the salt addition. This compares with the same inhibited crack-growth rates using a multi-functional inhibitor in the presence of 0.1M sodium chloride (Fig. 1).

Similar results for inhibition of crack-growth rates have also been demonstrated using the multi-functional inhibitor formulation on aluminum alloys. The effect of various environments is shown in Fig. 5 for 7075-T6Al. Figure 6 shows that the environmental effect is essentially eliminated by the use of the inhibitors--even in the presence of 0.1M sodium chloride. Likewise, the effectiveness of the inhibitor on 2024-T3Al is shown in Fig. 7.

Anodic polarization tests are also indicative of the effectiveness of inhibitors in reducing corrosion rates as measured by current density. In Fig. 8 the lowering of the current with the addition of the inhibitor is shown for 7075-T6Al. In Fig. 9, this effectiveness in reducing the current density is shown as a function of the chloride concentration at a constant inhibitor concentration. When high levels of chloride are expected, such curves can be utilized to yield an approximation of the inhibitor concentration required to inhibit corrosion over long periods of time. In most wash and rinse applications, the concentration of chloride and other aggressive contaminants is not expected to exceed a few hundred parts per million by weight in aqueous solution. At this level the concentrations given with borax at 0.35% and other components as indicated are effective. It is possible to track the concentration of the inhibitor in typical hard water, as shown in Fig. 10. In this example, X is the appropriate effective concentration of the inhibitor. At 0.5X and inhibitor is near the borderline for losing effectiveness, and a conductivity reading at that point indicates that more inhibitor should be added to a wash or rinse solution. This type of conductivity tracking is used in the Air Force Automated Rinse Facility.

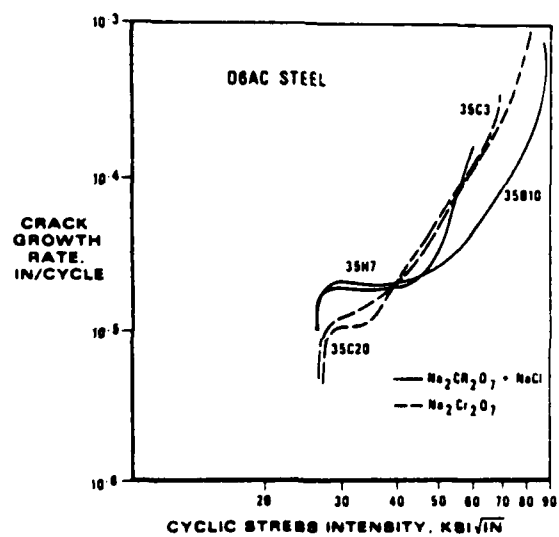


Figure 4. Influence of Chloride on Chromate Inhibition



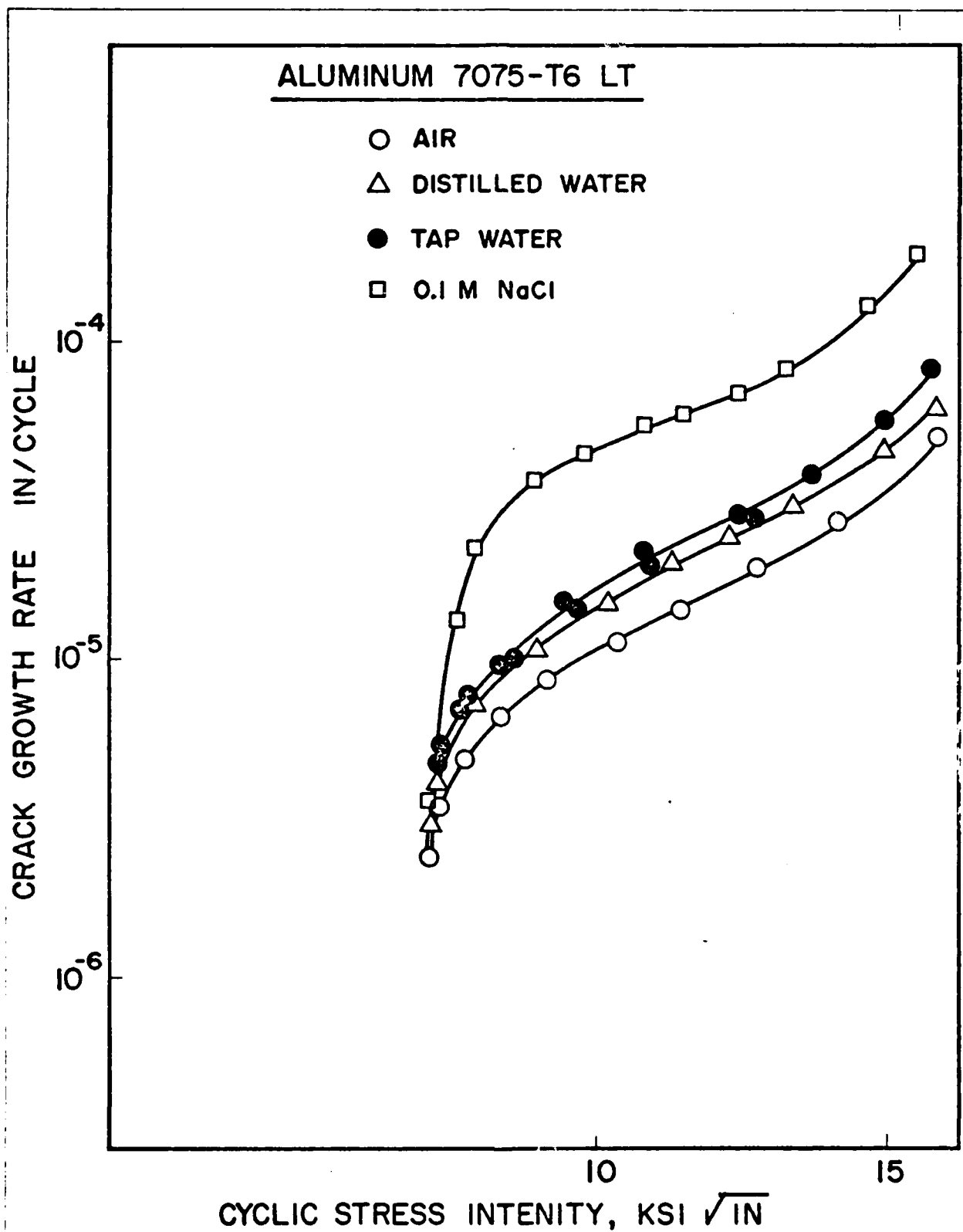


Figure 5. Corrosion fatigue of Al 7075-T6 LT

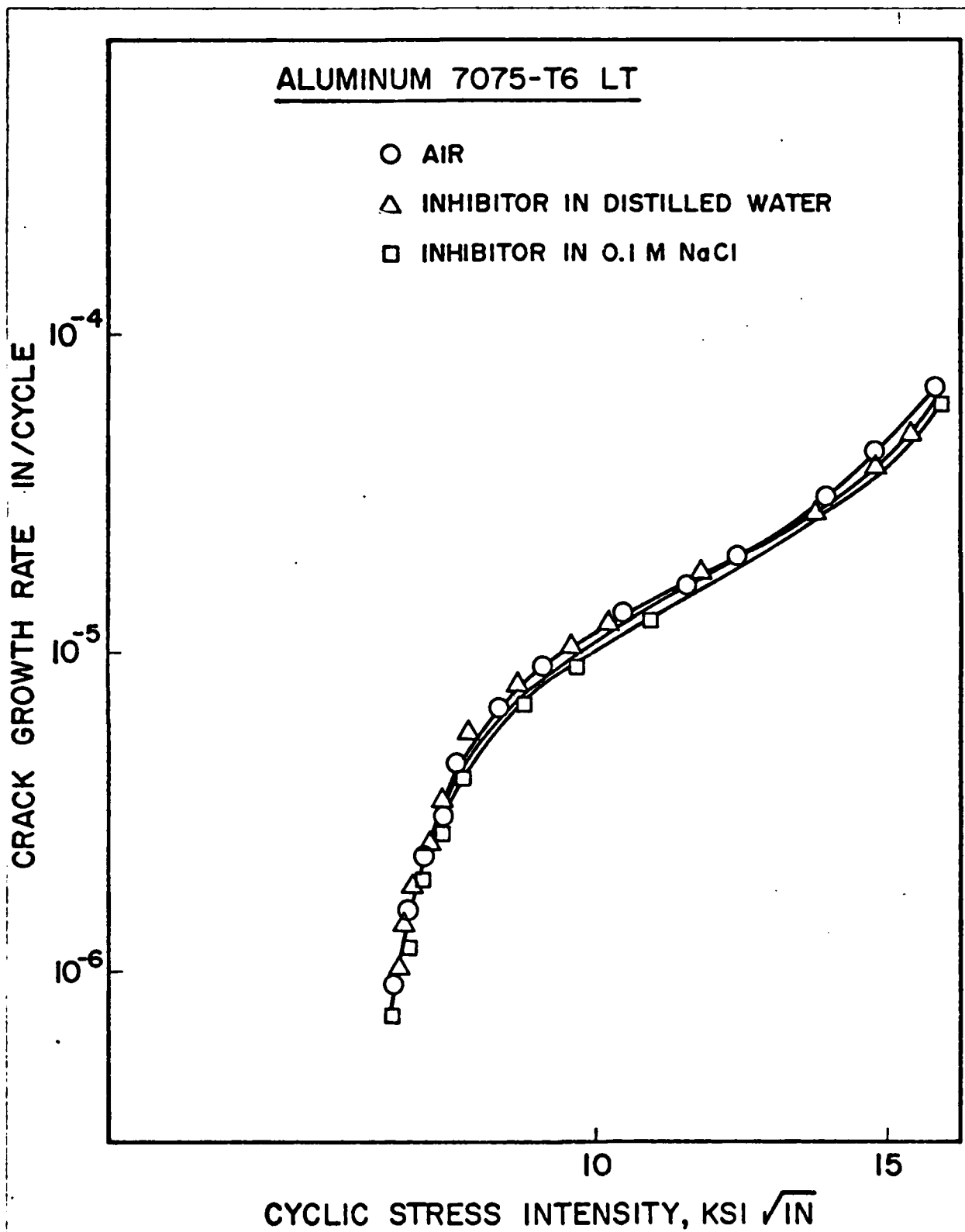


Figure 6. Effect of inhibitor upon corrosion fatigue of Al 7075-T6 LT

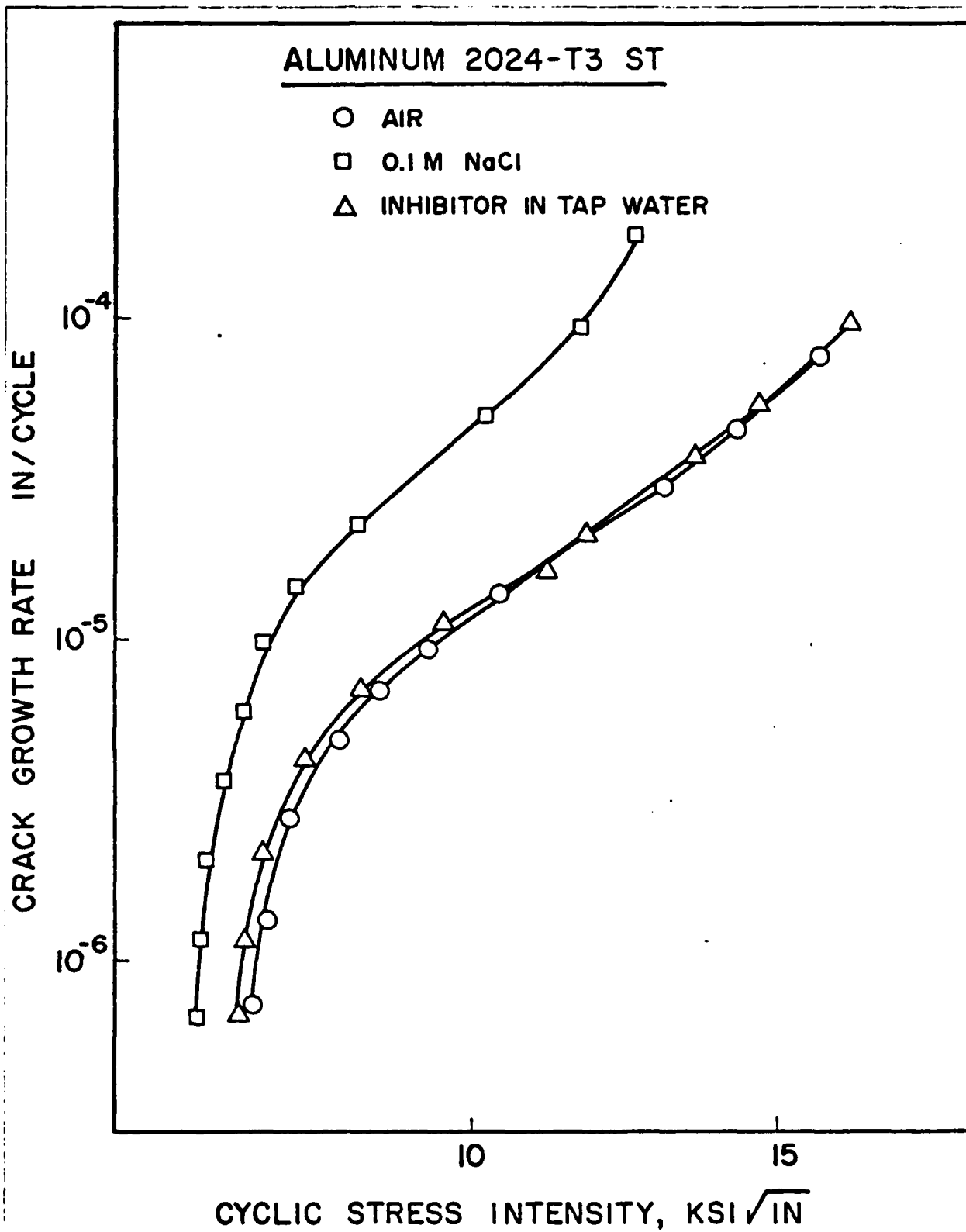


Figure 7. Corrosion fatigue of Al 2024-T3 ST

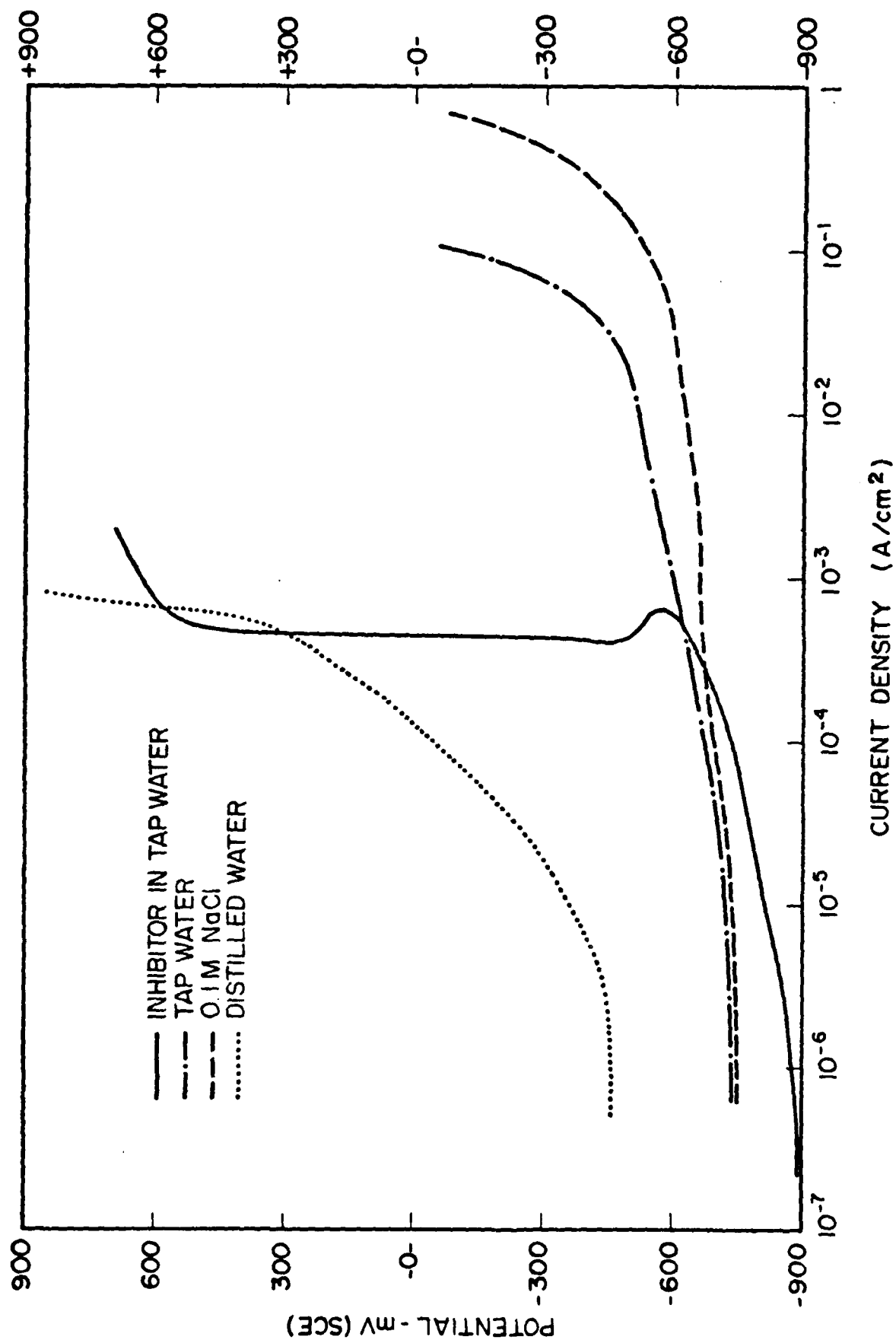


Figure 8. Anodic polarization of Al 7075-T6 in tap water, distilled water, 0.1M NaCl, and inhibitor solution

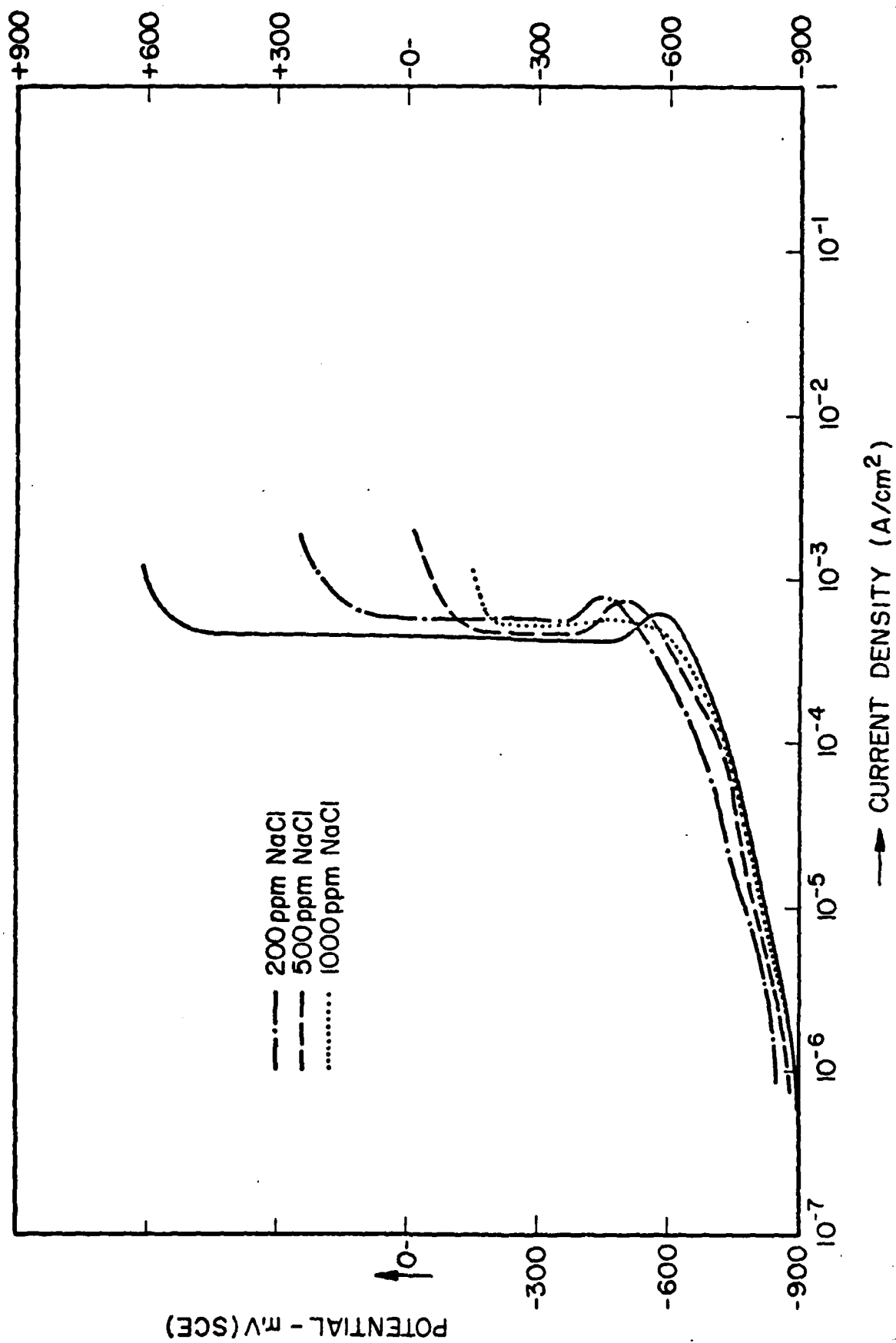


Figure 9. Effect of increasing chloride concentration upon the pitting behavior of Al 7075-T6 in an inhibited solution

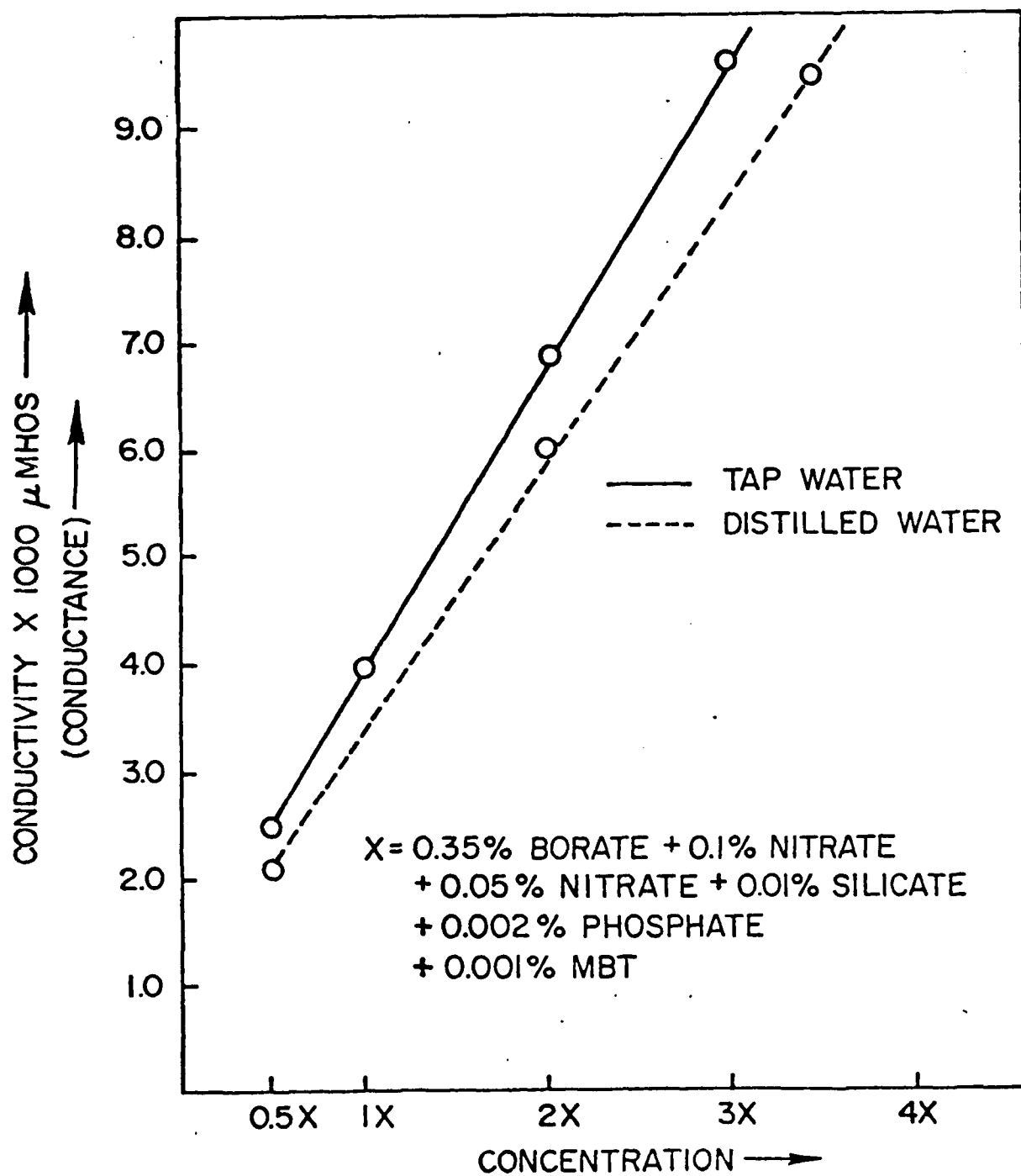


Figure 10. Calibration chart of conductivity as a function of concentration

The multi-functional inhibitors may also be used as contact inhibitors for dipping of corrosion-prone parts to impart a very thin inhibitive surface layer when the parts are to be stored in the atmosphere. This application has been tested on jet-engine parts at the Oklahoma City Air Logistics Center at Tinker Air Force Base. The advantage of such protection over lubricating oils and water-displacing compounds is that the surface protection can be easily removed by water rinse prior to assembly of parts that have been stored, whereas the alternative methods require special degreasing steps which are more expensive and time consuming. Commercially available contact inhibitors containing high nitrite concentrations (10 or more wt.%) are also reported to be effective but present handling problems at these levels of nitrite in the compositions

A new improved formulation has been developed to inhibit corrosion of ferrous and nonferrous aircraft structural materials in the presence of chloride concentrations higher than 1000 ppm. As shown earlier by Fig. 8, the borate-nitrite-base formulation provides protection to aluminum and steel in ordinary water; however, this inhibition is rendered insufficient with increasing concentration of the chloride ions, as shown by Fig. 9. This suggests that the passive film formed by this inhibitor formulation (which is a mixture of sodium salts of borate, nitrite, nitrate, silicate, phosphate, and MBT) is weak and ineffective against chloride attack when chlorine ions are present in high concentrations. When some of the surface active agents listed in Table II are added in low concentrations to the inhibitor formulation, the combined mixture is capable of inhibiting corrosion of aluminum and high-strength steels--even in an aqueous solution of 1M NaCl, as shown in Figs. 11 and 12.

The immersion results, as shown in Table III, demonstrate excellent performance of the phosphonate compounds SAD and SAP. These tests have been repeated and the results verified. The inhibiting property of this formulation in the presence of high chloride concentrations is remarkable. As a matter of fact, not a spot of corrosion was found in the test coupons of aluminum, steel, or brass which were immersed for more than eight months. No weight loss was detected, and complete protection was achieved by use of this inhibitor formulation in water

TABLE II. PROPRIETARY SURFACE ACTIVE AGENTS

Designation	Description
SAR	Sodium Dodecylbenzene Sulfonate
SAD	Sodium Salt of Phosphonic Acid
SAB	Corrosion Inhibitor with Complex Sulfonate Compound
SAM	Dialkyl Alkyl Phosphonates
SAP	High-Molecular-Weight Phosphonate
SAT	Octylphenoxy Polyethoxy Ethanol
SAO	High-Molecular-Weight Calcium Sulfonate
SAE	High-Molecular-Weight Barium Sulfonate
SAG	Sodium Salt of Complex Phosphate Ester



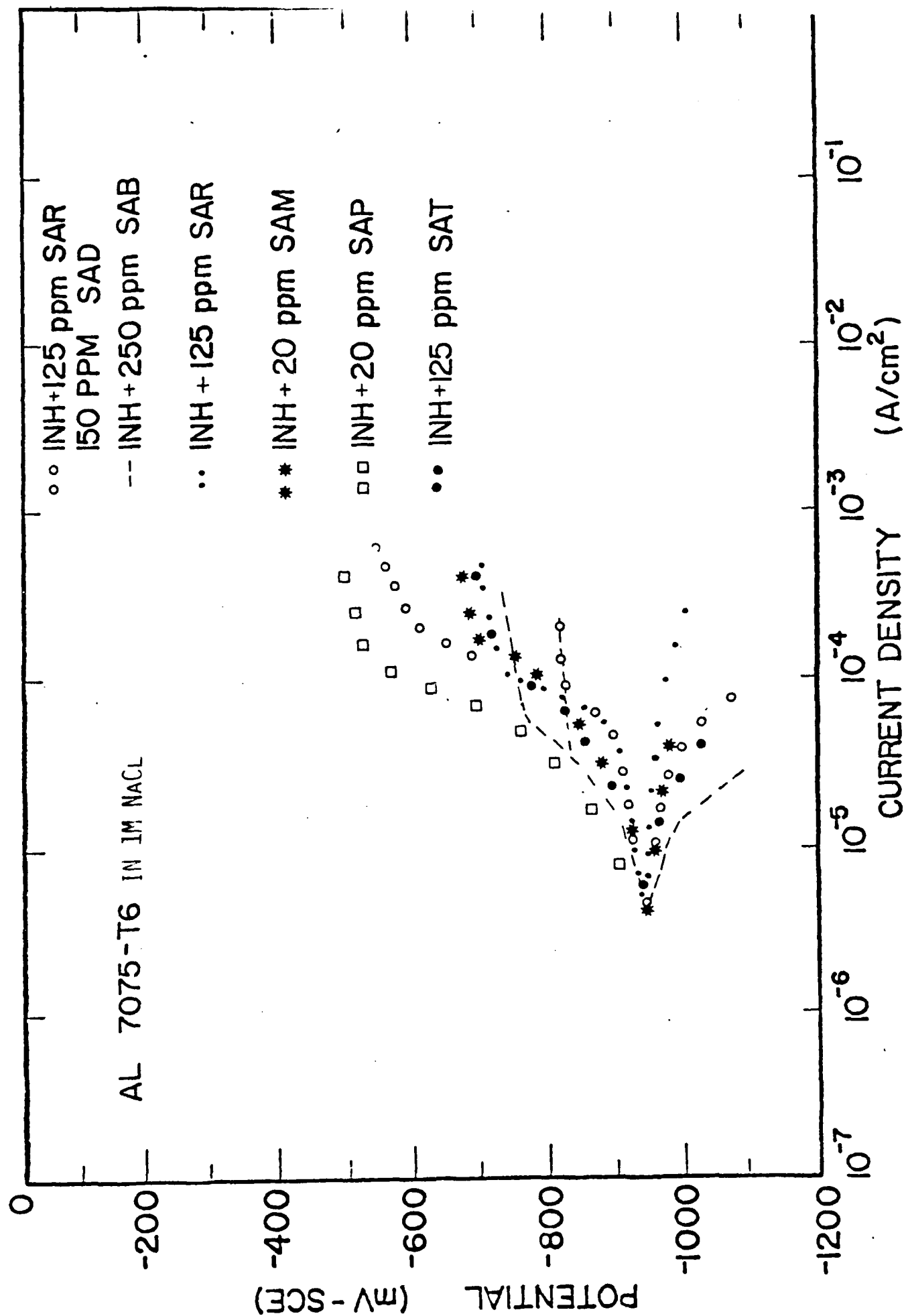


Figure 11. Effect of Surfactants upon the Polarization Behavior of AL7075-T6

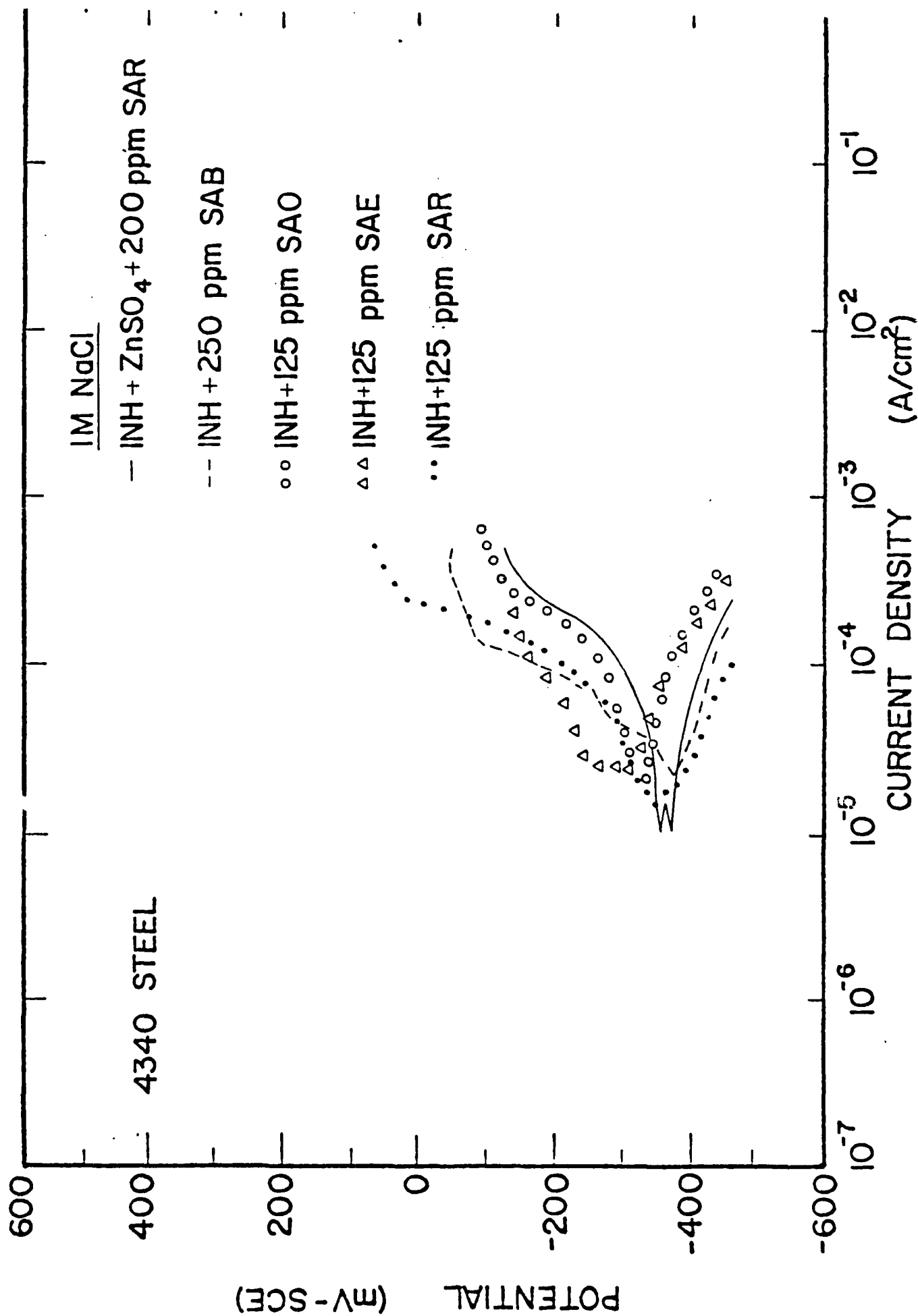


Figure 12. Effect of Surfactants upon the Polarization Behavior of 4340 Steel

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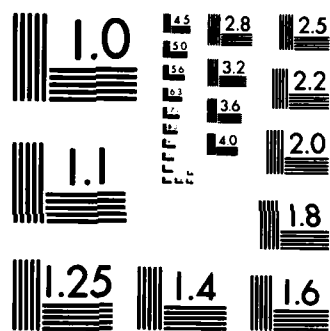
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE III

## IMMERSION TEST RESULTS ON AL AND STEEL SPECIMENS IMMersed TOGETHER

Spec. No.	Specimen	Inhibitor wt% in 1M NaCl	pH		Time of Exposure	Surface Appearance Visual Observation	Remarks
			Initial	Final			
1	Al 7075-T6 Steel	0.35 Borate + 0.2 Nitrate + 0.2 Nitrite + 0.01 Silicate + 50 ppm Phosphate + 30 ppm MBT + 100 ppm SAO.	7.90	7.90	2 weeks 2 weeks	Several pits. Clean and shiny; few fine pits.	Better inhibition required.
2	Al 7075-T6 Steel	0.35 Borate + 0.6 Nitrite + 0.6 Nitrate + 0.01 Silicate + 50 ppm Phosphate + 30 ppm MBT.	8.30	8.20	1 week 6 weeks 1 week 6 weeks	Clean. Few pits. Clean, few fine pits. Many pits at edge.	Better inhibition required.
3	Al 7075-T6 Steel	0.35 Borate + 0.05 Nitrite + 0.2 Nitrate + 0.01 Silicate + 50 ppm Phosphate + 50 ppm MBT + 100 ppm SAE.	8.20	8.15	1 month 4 months 1 month 4 months	Clean and shiny. " " Clean, pits around hole. Clean, several pits around hole.	Improvement required.
4	Al 7075-T6 Steel	0.35 Borate + 0.05 Nitrite + 0.2 Nitrate + 0.01 Silicate + 50 ppm Phosphate + 50 ppm Dimethyl Methyl-phosphonate.	8.2	8.25	2 weeks 2 weeks	Dull, patches of corrosion. Several pits.	Better inhibition required.
5	Al 7075-T6 Steel	0.35 Borate + 0.05 Nitrite + 0.1 Nitrate + 0.01 Silicate + 50 ppm MBT + 50 ppm Phosphate + 50 ppm SAP + 100 ppm SAE.	8.80	8.70	2 weeks 10 weeks 2 weeks 10 weeks	Clean. Clean, few corrosion streaks. Clean. Clean, pits near the hole.	Fair

TABLE III (Continued)

Spec. No.	Specimen	Inhibitor wt% in 1M NaCl	pH		Time of Exposure	Surface Appearance Visual Observation	Remarks
			Initial	Final			
6	Al 7075-T6	0.35 Borate + 0.2 Nitrite + 0.2 Nitrate + 0.01 Silicate + 125 ppm Phosphate + 60 ppm MBT + 100 ppm SAR + 210 ppm SAD + 40 ppm ZnSO <sub>4</sub> .	8.15	8.10	2 weeks	Clean and shiny.	Excellent inhibition.
					3 months	" "	
					2 weeks	" "	
					3 months	Clean and shiny, two fine pits near the hole.	
7	Al 7075-T6	0.35 Borate + 0.2 Nitrite + 0.2 Nitrate + 0.01 Silicate + 50 ppm Phosphate + 50 ppm MBT + 75 ppm SAT + 500 ppm ZnSO <sub>4</sub> .	8.15	8.20	2 weeks	Clean and shiny.	Excellent inhibition.
					2 months	" "	
					2 weeks	" "	
					2 months	" "	
8	Al 7075-T6	0.35 Borate + 0.2 Nitrite + 0.2 Nitrate + 0.01 Silicate + 100 ppm ZnSO <sub>4</sub> + 100 ppm MBT + 50 ppm Phosphate + 75 ppm SAR.	9.35	9.20	2 weeks	Clean and shiny.	Excellent inhibition.
					2 months	" "	
					2 weeks	" "	
					2 months	Clean and shiny, one fine pit on one corner.	
9	Al 7075-T6	1.00% SAB.	6.25	6.25	1 month	Clean and shiny.	Better inhibition required.
					6 months	Badly corroded.	
					1 month	Clean and shiny.	
					6 months	Badly corroded.	
10	Al 7075-T6	0.35 Borate + 0.2 Nitrite + 0.2 Nitrate + 0.01 Silicate + 100 ppm MBT + 50 ppm Phosphate + 250 ppm SAB.	8.15	8.20	2 weeks	Clean and shiny.	Excellent inhibition.
					2 months	" "	
					2 weeks	Clean, one pit appearing on one surface.	
					2 months	Clean and shiny.	

containing more salt (1M NaCl) than that present in sea water. The polarization behavior of this formulation was similar to that of the modified rinse inhibitor with SAR additions. Figures 13 and 14 show passive regions of approximately 200 and 300 mV for Al7075-T6 and 4340 steel, respectively. Again, comparing these results with the results shown in Fig. 9, a remarkable increase is observed in the protection of both aluminum and steel with small additions of surface active agents such as SAR. At a concentration of 1M NaCl, no protection is achieved by the regular borate-nitrite formulation, and only short-range protection is provided by increased additions of nitrite and nitrate.

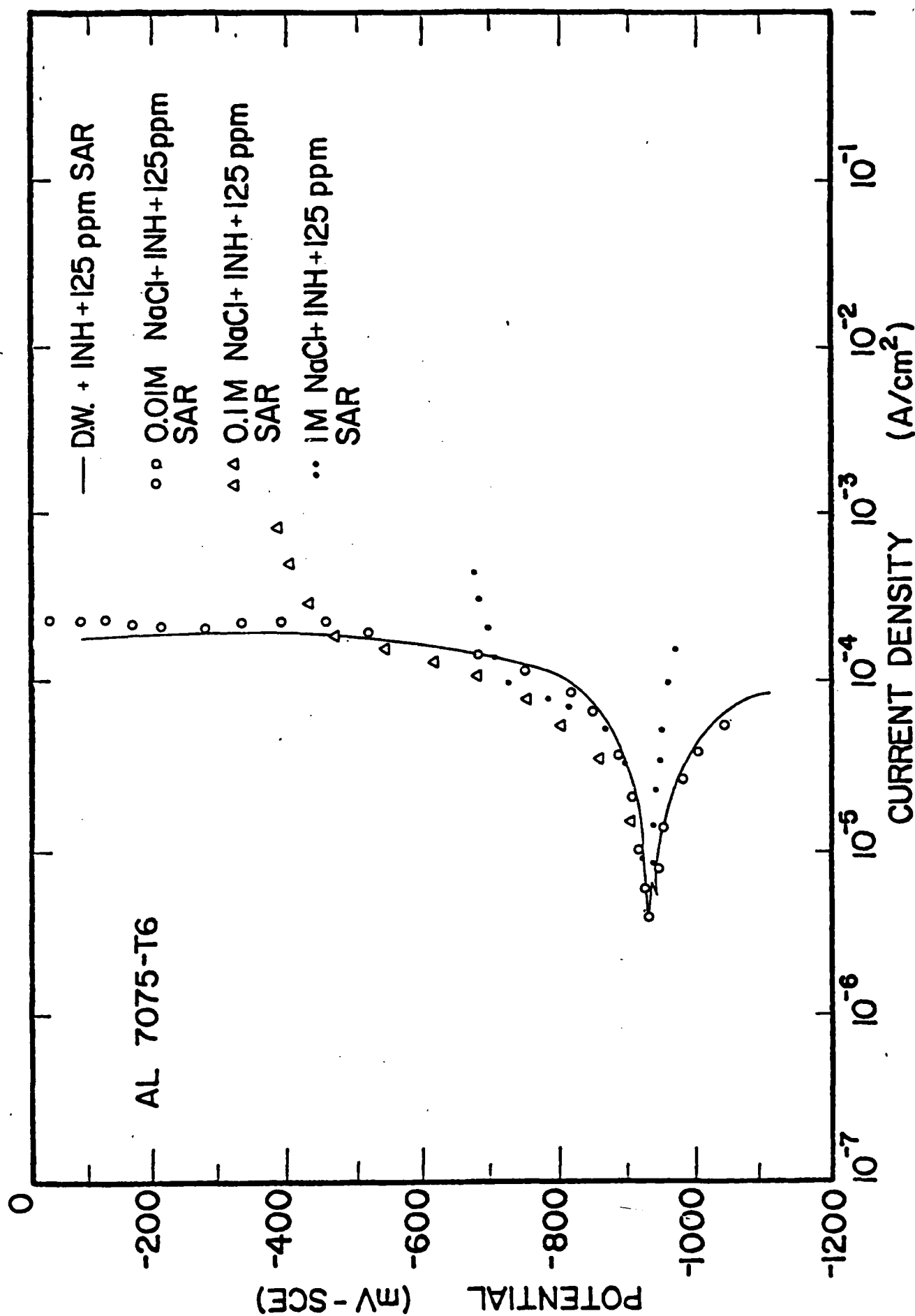


Figure 13. Effect of Increasing Chloride Concentration upon the Passivity of Al7075-T6 in the Presence of SAR



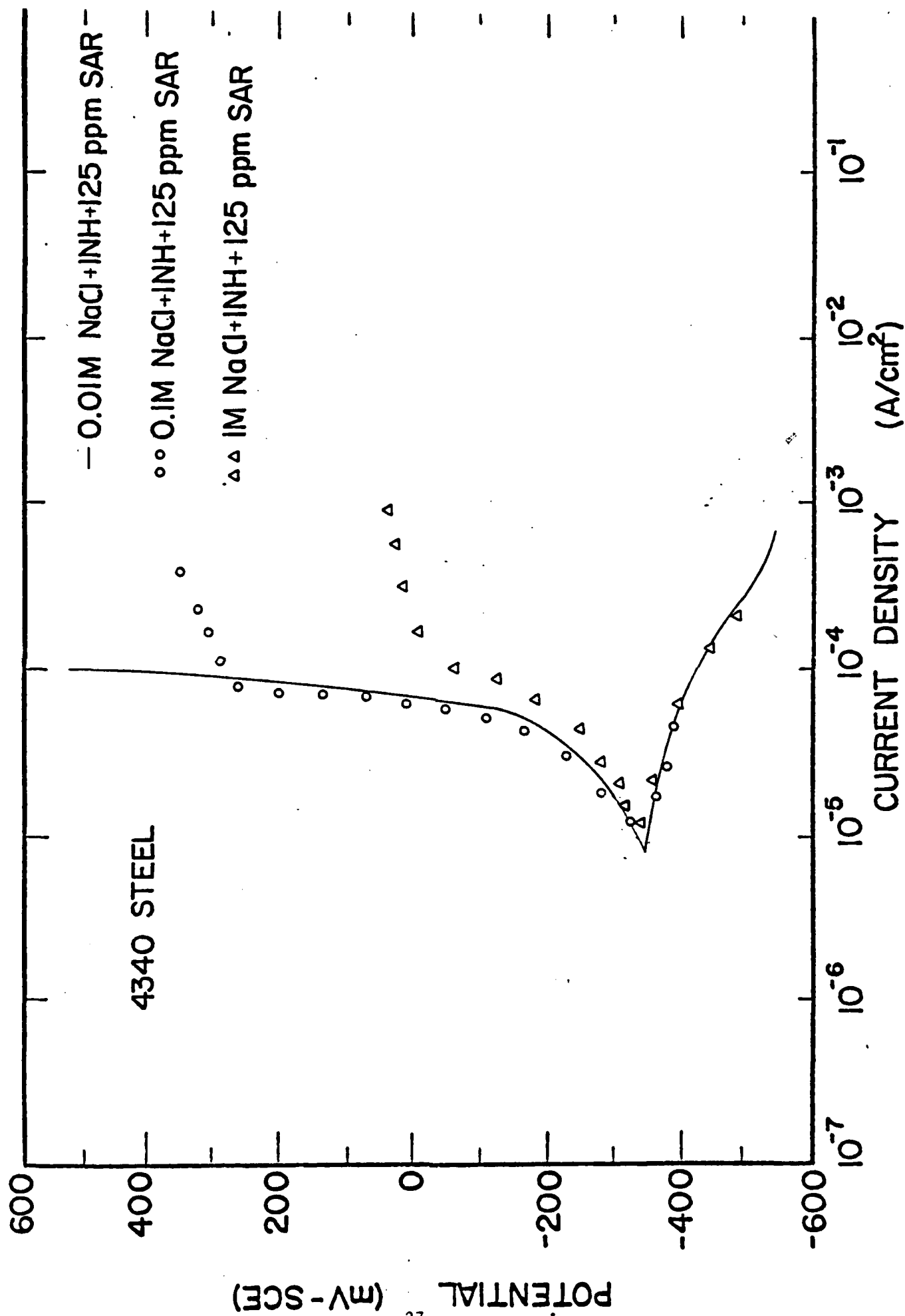


Figure 14. Effect of Increasing Chloride Concentration upon the Passivity of 4340 Steel in the Presence of SAR

## SECTION 4

### APPLICATIONS

The borax-nitrite-base inhibitor with additions of nitrate, polyphosphate, meta-silicate, and mercaptobenzothiazole was recommended for use in the Air Force Rinse Facility as a result of the research efforts in 1978. Experimental use commenced in the summer of 1978 with inhibitors added to the rinse water. In August of 1979 a full-scale test program to evaluate the use of an inhibited rinse was begun on F-4 aircraft stationed at MacDill Air Force Base. The missions of these aircraft emphasize over-sea water exercises at low altitudes; MacDill Air Force Base itself is surrounded on three sides by salt water. In addition, the Tampa industrial area contributes substantial suspended particulates and sulfur dioxide to the atmosphere. Thus, it is considered to be a prime area for conducting such tests for the use of automated rinsing to reduce contamination of surfaces and subsequent increased corrosion on operational aircraft. Twenty-five F-4 fighter aircraft were selected to use the Rinse Facility, and a second group of twenty-five F-4's not using the facility was designated as a control group. This test program is still underway, and it is planned that tracking of maintenance costs and corrosion damage will be completed within the next year.

Some problems have arisen with the maintenance of a discrete population of aircraft within the test group and the control group, since some aircraft have been transferred to other stations. It now appears, however, that at least one-half of both groups will be maintained at MacDill Air Force Base for a sufficient time to complete a two to three year test program. As far as the author knows, this is the first attempt to actually track maintenance costs in the use of aircraft rinsing facilities. The general observation has been that this practice is "beneficial," but no cost-effectiveness studies have been conducted.

A view of the Rinse Facility at MacDill Air Force Base is given in Fig. 15. The holding tanks for rinse water, major piping and pumping systems, return tanks, etc., are located underground. Only the control facilities are above ground.

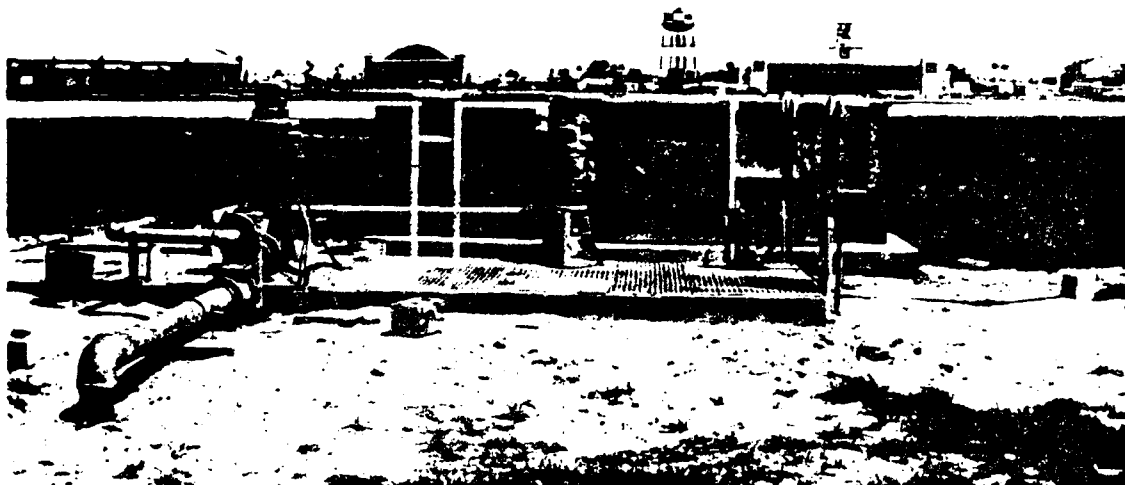


Figure 15. View of the USAF Automated Rinse Facility.



Figure 16. F-4 Aircraft Taxiing through the Rinse Facility.

The inhibitors are added to a tank holding approximately 11,000 liters of water (approximately 3,000 gallons). A forced-air system mixes the inhibitors to effect full desolution within about 1 min. after addition, and a conductivity bridge is used to monitor inhibitor concentration in the rinse water. When an aircraft passes over an induction coil on the runway, it triggers the rinse system to deliver approximately 560 liters of rinse water in a 15-20 sec. time period, pumping at approximately 2,250 liters per minute at the maximum point after startup. Water jets below the runway/taxiway surface direct water to various parts of the aircraft. An F-4 aircraft as it taxis through the facility is shown in Fig. 16.

The method of monitoring the rinse-inhibitor concentration by following the change in conductivity is shown in Fig. 10. Laboratory experiments have shown this to be a reliable and accurate method. The Rinse Facility provides for discharge of the effluent water periodically as contaminants build up and for the removal of oily water to appropriate disposal facilities. In actual practice, 100 - 200 liters of water are lost on the runway and not returned to the holding tanks after each aircraft rinse. Fresh water is added to the holding tank at this point, and tracking of the inhibitor concentration is essential in determining when additional inhibitors should be added. While this could be accomplished automatically, in the current test it is done manually.

The newer improved formulation increases the effectiveness of the original rinse inhibitor by providing effective protection of higher-concentration ranges of contaminants in the rinse water when it is recycled. This would be a function of the rate of buildup of contaminants. Preliminary tests also indicate that spotting of windshields and aircraft canopies is reduced with the improved formulation (when the rinse water is very hard, such as at MacDill Air Force Base). This change in the rinse-inhibitor composition is planned for late spring of 1982. This inhibitor formulation has been reported to be in application at several places, for example, the city of Kettering Ohio, has an experimental plan to subject all city highway vehicles to an inhibited wash. The visual results are encouraging, but the qualitative data are not available as yet. In another

example, this formulation is being used as a contact inhibitor for weapons and other systems which require long-term storage at Tinker Air Force Base in Oak City, Oklahoma. A definite advantage of this inhibitor over other preventive compounds, which contain some greasy or oily ingredient, is that it can be easily washed away by a simple water spray, while the others require a special cleaning treatment. This formulation has been reported to be in use for more than one year with good results. Unfortunately, no quantitative data are available.

Some efforts have been made to compact the inhibitor into small cakes (pellets). These cakes may be tested in Air Force aircraft in the spring of 1982 in long-term (several-year) type tests. The cakes have been tested in the laboratory. They contain the inhibitors which are released slowly when they come in contact with aqueous corrosive media.

Currently, attempts are being made to adapt the inhibitor formulation to spray form also.

## SECTION 5

### DATA TRACKING

The laboratory test data on the performance of the inhibitor are conclusive. The inhibitor has been prepared from a series of compounds which are nontoxic and soluble in aqueous solution and provide low-cost corrosion protection for a broad spectrum of metallic structures in aggressive environments. It has been well established that there is a very definite need for this inhibitor at various Air Force facilities. Experience at the Automated Rinse Facility at MacDill Air Force Base has suggested some definite advantages of inhibited rinsing of aircraft; however, some data-tracking problems exist. It is strongly suggested that this inhibitor be introduced into various vehicle systems and that a program be set up for data tracking. The laboratory tests and initial field results are very encouraging. At this point there is a definite need for a planned application of this inhibitor with a set program for tracking data. Quantitative maintenance data will aid in the evaluation of the cost savings attainable by the use of this corrosion-prevention technique.

SAMPLE LIST - VEHICLES WHICH COULD BE PURCHASED WITH \$37 MILLION

<u>VEH. TYPE</u>		<u>UNIT COST</u>		<u>QUANTITY</u>		<u>QUANTITY COST</u>
PU	-	\$ 5,919	X	450	=	\$ 2,663,550
MED/SDN	-	3,372	X	300	=	1,011,600
29 PAX BUS	-	31,548	X	15	=	473,220
R 9 REFUEL	-	91,442	X	125	=	11,430,250
METRO VAN	-	8,853	X	250	=	2,213,250
AGE TRACT	-	13,369	X	250	=	3,342,250
RUNWAY VAC SWEEPER	-	30,738	X	150	=	4,610,700
6 K F/L	-	23,449	X	218	=	5,111,882
P-4 FIRE TRK	-	204,172	X	<u>30</u>	=	<u>6,125,160</u>
				TOTAL 1788		\$ 36,981,862

COMPARISON CHART - AVAILABLE RUSTPROOFING METHODS

VEHICLE RUSTPROOFING	CURRENT METHOD	WR-ALC PROPOSAL	AFMFC PROPOSAL
1. MFG Rustproofing for Admin. Vehicles IAW MIL STD-1223	FY 81 cost estimated at 1.5% of purchase price*	Estimated at least 1.5% of purchase price**	0 [ Would allow purchases of \$37 million of additional vehicles during FY 83-87 ]
2. MFG Rustproofing for Non-Admin. Vehicles IAW Mil STD-1223U	0	Estimated at least 1.5% of purchase price**	0
3. Navy CORTREAT (Non-Admin Veh)	FY 81 est. \$455,000 (1.5% of purchase price)	0	0
4. Initial Acceptance Inspection	0	\$36 for each new vehicle	0
5. Training for Initial Inspection, Annual Inspection and touch	\$720 at locations performing in-house/contract rustproofing***	\$720 at each of 134 AF bases. Total \$96,480	\$720 at locations performing in-house/contract rustproofing***
6. Rustproofing Equipment	\$1050 at locations performing in-house rustproofing***	\$1050 at each of 134 AF bases. Total \$140,700	\$1050 at locations performing in-house rustproofing***
7. Rustproofing Material	Average \$60 per vehicle at locations performing in-house rustproofing***	0	Average \$60 per vehicle at locations performing in-house rustproofing***
8. Annual Inspection	0	\$9 for each vehicle at each AF base	\$9 per vehicle at locations performing in-house/contract rustproofing***



9. Control over Quality - Admin Vehicles - Non-Admin Vehicles	- None - None	- None - None	- Total - Total
10. Availability of Warranty - Admin Vehicles - Non-Admin Vehicles	- STD MFG Warranty - None	- STD MFG Warranty - 5 year	- 5 year - 5 year
11. Delivery delays - Admin Vehicles - Non-Admin Vehicles	- 14-30 days - 14-30+ days	- 14-30 days - 14-30 days	- None - in-house treatment - average 1 day - None - contract treatment - average 7 days

\* - Cost for light vehicles ran as high as 3.0%, less for heavier vehicles.

\*\* - New Version of MIL STD 1223 calls for more rustproofing plus significant administrative effort not previously required.

\*\*\* - It is estimated that less than 25% of Air Force bases would be involved.

COST COMPARISON-WARNER ROBINS' PROPOSAL VS. AFLMC'S PROPOSAL - FY 83-87

-3080 FUNDING-		O&M FUNDING-					
	FLEET-WIDE RUSTPROOFING BY MANUFACTURER	ACCEPTANCE INSPECTION	FOLLOW-ON INSPECTION	RUSTPROOF EQUIPMENT	TRAINING	LOCAL RUSTPROOFING (LABOR/MATERIAL)	TOTAL O&M
WARNER ROBINS' PROPOSAL	\$37,000,000 <sup>1</sup>	\$3,913,056 <sup>2</sup>	\$1,956,510 <sup>3</sup>	\$140,700 <sup>4</sup>	\$96,480 <sup>5</sup>	\$0 <sup>6</sup>	\$6,106,746
AFLMC'S PROPOSAL	\$0 <sup>7</sup>	\$0 <sup>8</sup>	\$489,132 <sup>9</sup>	\$35,700 <sup>10</sup>	\$24,480 <sup>11</sup>	\$4,130,448 <sup>12</sup>	\$4,679,760
NET SAVINGS	\$37,000,000	\$3,913,056	\$1,467,396	\$105,000	\$72,000	-\$4,130,448	\$1,427,004
NET SAVINGS FY 83-87 - \$38,427,004							

NET SAVINGS FY 83-87 - \$38,427,004

## COMPUTATIONS

1.  $\$2,500,000,000 \times 1.5\% = \$37,000,000$

This formula multiplies the total cost of the vehicle buy program for FY 83-87 times the projected percent of purchase price that buys manufacturer's rustproofing. The result is the cost of manufacturer's rustproofing for the entire vehicle buy for FY 83-87.

2.  $108,696 \times \$36 = \$3,913,056$

This formula multiplies the total number of vehicles to be purchased during FY 83-87 times the cost of conducting an acceptance inspection. The result is the cost of conducting acceptance inspections for the entire vehicle buy for FY 83-87. The total number of vehicles to be purchased was estimated by taking the total cost of the FY 83-87 vehicle buy and dividing by an estimated cost per individual vehicle (\$25K). The cost for each acceptance inspection was estimated by multiplying the official hourly labor rate for E-4 labor, \$9, by four hours, the estimated time necessary to disassemble, inspect and reassemble an average vehicle.

3.  $217,392 \times \$9 = \$1,956,510$

This formula multiplies the total number of follow-on inspections required during FY 83-87 times the cost of conducting a follow-on inspection. The number of follow-on inspections required was estimated by adding the total number of follow-on inspections for each FY during 83-87. An evenly distributed purchase of vehicle

was assumed. Therefore, during FY 83 there would be no follow-on inspections; during FY 84 there would be follow-on inspections for the 20% of the fleet already purchased; during FY 85 there would be follow-on inspections for the 40% of the fleet that was already purchased; during FY 86 there would be inspections for the 60% of the fleet that was already purchased; and during FY 87 there would be follow-on inspections for the 80% of the fleet already purchased. The cost for each follow-on inspection was estimated by multiplying the official hourly labor rate for E-4 labor by the estimated time it takes to perform the inspection, i.e., one hour.

4.  $134 \times \$1050 = \$140,700$

This formula multiplies the total number of major Air Force installations times the cost of rustproofing equipment for each installation. The number of major Air Force installations was obtained from the Pocket Summary, President's FY 1983 Budget, published by HQ USAF/ACM. The cost for rustproofing equipment was provided by Patrick AFB's Vehicle Maintenance Office, a fully equipped rustproofing facility.

5.  $134 \times \$720 = \$96,480$

This formula multiplies the total number of major Air Force installations times the cost of training one man to properly rustproof vehicles. The cost of training one man was estimated by taking the official hourly rate for E-4 labor times 80 hours that is required to complete the training. Training time was supplied by Patrick AFB.

6. \$0

Vehicle rustproofing under the Warner Robins' proposal would be accomplished at the time of purchase. We realize there would be a cost to bring those vehicles failing the acceptance inspection up to standards, however, for this comparison we are assuming a 100% compliance with MIL STANDARD 1223 by the manufacturer.

7. \$0

Our proposal entails no rustproofing by the manufacturer.

8. \$0

Under the AFLMC's proposal vehicles would arrive at their destinations with no rustproofing applied; therefore, no acceptance inspection is required.

9.  $54,348 \times \$9 = \$489,132$

This formula multiplies the total number of follow-on inspections required during FY 83-87 times the cost of a follow-on inspection. We assumed that at most 25% of the bases will require rustproofing of their vehicles. This assumption was based on the Pacer Lime survey's findings that only 16% of the bases exist in severe corrosive environments. We also assumed that 100% of the vehicles received at these bases will be rustproofed as a margin of safety. The cost for each follow-on inspection was estimated at the official hourly labor rate for E-4 labor.

10.  $34 \times \$1050 = \$35,700$

This formula multiplies the number of Air Force installations requiring rustproofing times the cost of providing rustproofing equipment for a single base. As stated earlier, an estimated 25% of the bases; i.e., 34 bases, will require vehicle rustproofing. The cost of providing rustproofing equipment for a single base was supplied by Patrick AFB.

11.  $34 \times \$720 = \$24,480$

This formula multiplies the estimated number of Air Force installations requiring rustproofing times the cost of training one man in rustproofing procedures. The cost of training one man was estimated by taking the official hourly rate for E-4 labor times the 80 hours required to complete such training. Training time was supplied by Patrick AFB.

12.  $27,174 \times \$152 = \$4,130,448$

This formula multiplies the number of vehicles, purchased during FY 83-87, requiring rustproofing times the cost of rustproofing a single vehicle. The number of vehicles requiring rustproofing is based on the estimation that the vehicles will be evenly distributed amongst the installations and that only 25% of the installations will require rustproofing for their vehicles. The cost of rustproofing a single vehicle is based on material and labor hours provided by Patrick AFB's Vehicle Maintenance office.